PB-229 622

TECHNICAL MEMORANDA FOR MUNICIPAL, INDUSTRIAL AND DOMESTIC WATER SUPPLIES, POLLUTION ABATEMENT AND PUBLIC HEALTH-SUWANNEE BASIN

Public Health Service
Atlanta, Georgia

June 1962

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

SUWANNEE
BASIN
PB 229 622

NTIS [illegible] 42

TECHNICAL MEMORANDA
FOR
WATER SUPPLIES
POLLUTION ABATEMENT
AND
PUBLIC HEALTH

PREPARED FOR
UNITED STATES STUDY COMMISSION, SOUTHEAST RIVER BASINS
BY
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE, REGION IV
WATER SUPPLY & POLLUTION CONTROL PROGRAM
ATLANTA, GEORGIA
JUNE 1962

Library
Environmental Protection Agency
Region VII

UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region IV
Water Supply and Pollution Control Program

Technical Memoranda

for

Municipal, Industrial and Domestic Water Supplies
Pollution Abatement
Public Health

SUWANNEE BASIN

Prepared for

United States Study Commission,
Southeast River Basins
Atlanta, Georgia
June 1962

ii

UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region IV
Water Supply and Pollution Control Program

Technical Memoranda

for

Municipal, Industrial and Domestic Water Supplies
Pollution Abatement
Public Health

SUWANNEE BASIN

Prepared for

United States Study Commission,
Southeast River Basins
Atlanta, Georgia
June 1962

>K<

TABLE OF CONTENTS

LIST OF TABLES vii

LIST OF FIGURES ix

INTRODUCTION

PREFACE

Scope I-2

Authority I-2

Economic Basis for Planning I-3

RESPONSIBILITIES

Public Health Service, Department of Health, Education, and Welfare I-4

Corps of Engineers, Department of the Army I-5

Soil Conservation Service, Department of Agriculture I-5

Forest Service, Department of Agriculture I-5

Geological Survey, Department of the Interior I-6

National Park Service, Department of the Interior .. I-6

Atomic Energy Commission I-6

Florida State Board of Health I-6

Local Health Departments (Florida) I-7

Florida Board of Conservation I-7

Florida Game and Fresh Water Fish Commission I-7

Florida Geological Survey I-7

Georgia Department of Public Health I-8

Local Health Departments (Georgia) I-9

Georgia Oil and Gas Commission I-9

Georgia Game and Fish Commission I-10

Georgia Water Quality Council I-10

(6/1/62

2<

RESPONSIBILITIES - Cont'd | Page

Georgia Department of Mines, Mining, and Geology I-10

Georgia Resources Commission I-10

Water Purveyors I-10

DESCRIPTION OF THE BASIN

General I-11

Climate and Hydrology I-11

Population I-12

Resources I-13

MUNICIPAL, INDUSTRIAL, AND DOMESTIC WATER SUPPLIES

INTRODUCTION

Scope of Memorandum W-2

Procedures and Investigations W-2

Basic Assumptions W-3

QUANTITY AND QUALITY OF WATER AVAILABLE FOR WATER SUPPLIES

Surface Water W-4

Ground Water W-4

MUNICIPAL WATER SUPPLIES

Inventory W-5

Present Status of Water Supply Systems W-5

Water Supply System Requirements for 1960 .... W-6

Future Water Supply System Requirements W-6

Future Water Supply Problems W-6

Annual Costs W-7

MUNICIPAL WATER SUPPLIES - Cont'd

Page

Benefits W-21

DOMESTIC WATER SUPPLIES

Inventory W-21

Present Status of Water Supply Systems W-22

Water Supply System Requirements for 1960 .... W-22

Future Water System Requirements W-22

Annual Costs W-23

INDUSTRIAL WATER SUPPLIES

Inventory W-24

Present Status of Water Supply Systems W-24

Future Water Supply Requirements for 1975 and 2000.. W-24

Future Water Supply Problems W-27

Annual Costs W-27

Benefits W-28

SUMMARY

POLLUTION ABATEMENT

INTRODUCTION

Scope of Memorandum P-2

Procedures and Investigations P-2

Basic Assumptions P-2

General P-3

INVENTORY OF POLLUTION ABATEMENT

Sources of Pollution P-4

Existing Sewage Treatment Facilities P-5

INVENTORY OF POLLUTION ABATEMENT - Cont'd Page

Effects on Streams P-10

POLLUTION ABATEMENT REQUIREMENTS FOR 1960

Sewerage P-13
Treatment Facilities P-14
Other Needs P-14

FUTURE POLLUTION ABATEMENT REQUIREMENTS

Projections P-15
Sewerage P-15
Treatment Facilities P-27

LOW FLOW AUGMENTATION

General P-28
Areas Where Augmentation Is Not Needed P-28
Areas Where Augmentation Is Needed P-28

ANNUAL COSTS AND BENEFITS

Financing P-34
Annual Costs for 1960 .... P-35
Annual Costs by 1975 .... P-35
Annual Costs by 2000 .... P-36
Benefits P-36

SUMMARY

PUBLIC HEALTH

INTRODUCTION

VECTOR CONTROL

Introduction PH-2

(6/1/62)

VECTOR CONTROL - Cont'd

Page
Existing Vector Problems PH-2
Status of Existing Programs PH-5
Existing Needs PH-6
Potential Problems and Solutions PH-8
Costs and Benefits PH-9

AIR POLLUTION

Problems PH-12
Status of Existing Programs PH-12
Existing Needs PH-13
Potential Problems and Solutions PH-13
Costs and Benefits PH-14

RADIOLOGICAL HEALTH

Problems PH-14
Status of Existing Programs PH-15
Existing Needs PH-15
Potential Problems and Solutions PH-20

SOLID WASTES

Introduction PH-20
Problems PH-20
Status of Existing Programs PH-21
Existing Needs PH-21
Potential Problems and Solutions PH-21
Costs and Benefits PH-22

(6/1/62)

SUMMARY AND CONCLUSIONS

Page
Summary PH-23
Conclusions PH-24

APPENDIX

BIBLIOGRAPHY

LIST OF TABLES

MUNICIPAL, INDUSTRIAL AND DOMESTIC WATER SUPPLIES

Table Page

W-1 Basic Data on Municipal Water Supply Systems .. W-8

W-2 Municipal Water Supply Systems Estimated Needs and Costs for 1960 .... W-11

W-3 Municipal Water Supply Systems Estimated Needs and Costs for 1975 .... W-13

W-4 Municipal Water Supply Systems Estimated Needs and Costs for 2000 .... W-17

W-5 Basic Data on Industrial Water Supply Systems.. W-25

W-6 Industrial Water Supply Systems Estimated Needs and Costs - 1975 and 2000 .... W-26

POLLUTION ABATEMENT

P-1 Basic Data on Sources of Municipal Pollution .. P-6

P-2 Basic Data on Sources of Industrial Pollution.. P-8

P-3 Municipal Pollution Abatement Estimated Needs and Costs for 1960 .... P-16

P-4 Industrial Pollution Abatement Estimated Needs and Costs for 1960 .... P-17

P-5 Sources of Municipal Sewage - 1975 and 2000 ... P-18

P-6 Sources of Industrial Waste - 1975 and 2000 ... P-22

P-7 Municipal Pollution Abatement Estimated Costs - 1975 and 2000 .... P-24

P-8 Industrial Pollution Abatement Estimated Costs - 1975 and 2000 .... P-26

P-9 Minimum Flow Requirements P-29

P-10 Reservoir Storage Needs P-34

(6/1/62)

8<

PUBLIC HEALTH

Table		Page
PH-1	Vector Problems and Programs	PH-10
PH-2	Radioactivity in Water	PH-16
PH-3	Land Requirements for Sanitary Landfills	PH-22
PH-4	Solid Wastes Program Annual Costs	PH-23

LIST OF FIGURES

Figure Page

I-1 Southeast River Basins I-1

W-1 Municipal and Industrial Water Supplies W-1

P-1 Sources of Pollution P-1

INTRODUCTION

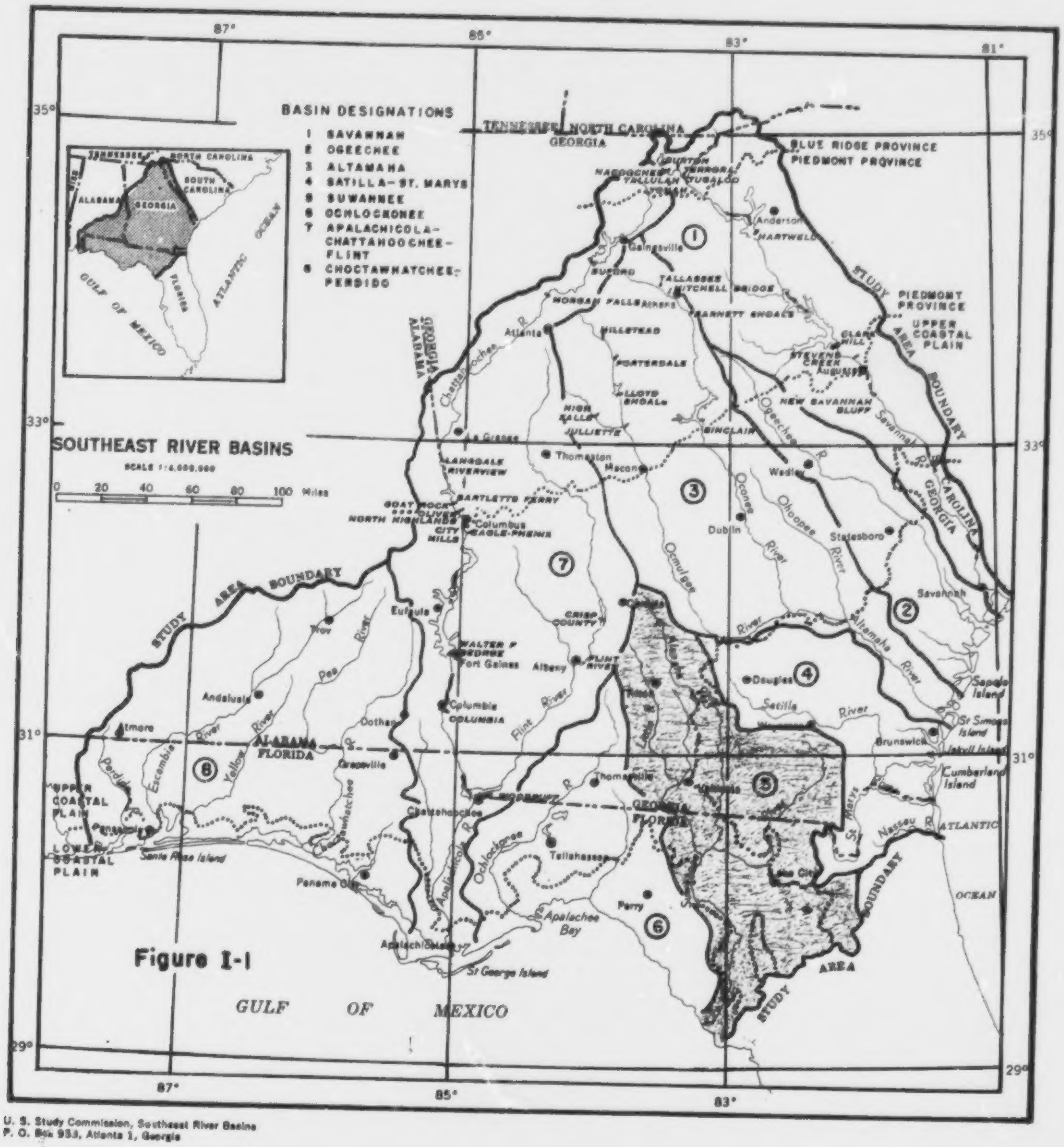

SOUTHEAST RIVER BASINS
SCALE 1:4,000,000
0 20 40 60 80 100 Miles
BASIN DESIGNATIONS
1 SAVANNAH
2 OGEECHEE
3 ALTAMAHA
4 SATILLA-ST. MARYS
5 SUWANNEE
6 OCHLOCKONEE
7 APALACHICOLA-CHATTAHOOCHEE-FLINT
8 CHOCTAWHATCHEE-PERDIDO
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
BLUE RIDGE PROVINCE
PIEDMONT PROVINCE
UPPER COASTAL PLAIN
LOWER COASTAL PLAIN
STUDY AREA BOUNDARY
Atlanta
Gainesville
Anderson
HARTWELL
Augusta
Macon
Thomaston
La Grange
Columbus
Eufaula
Dublin
Wadley
Statesboro
Savannah
Douglas
Brunswick
Albany
Dothan
Thomasville
Tallahassee
Perry
Panama City
Pensacola
Apalachicola
Andalusia
Troy
Atmore
Sapelo Island
St Simons Island
Jekyll Island
Cumberland Island
Santa Rosa Island
St George Island
Apalachee Bay
87°
85°
83°
81°
35°
33°
31°
29°

Figure I-1

U. S. Study Commission, Southeast River Basins
P. O. Box 953, Atlanta 1, Georgia

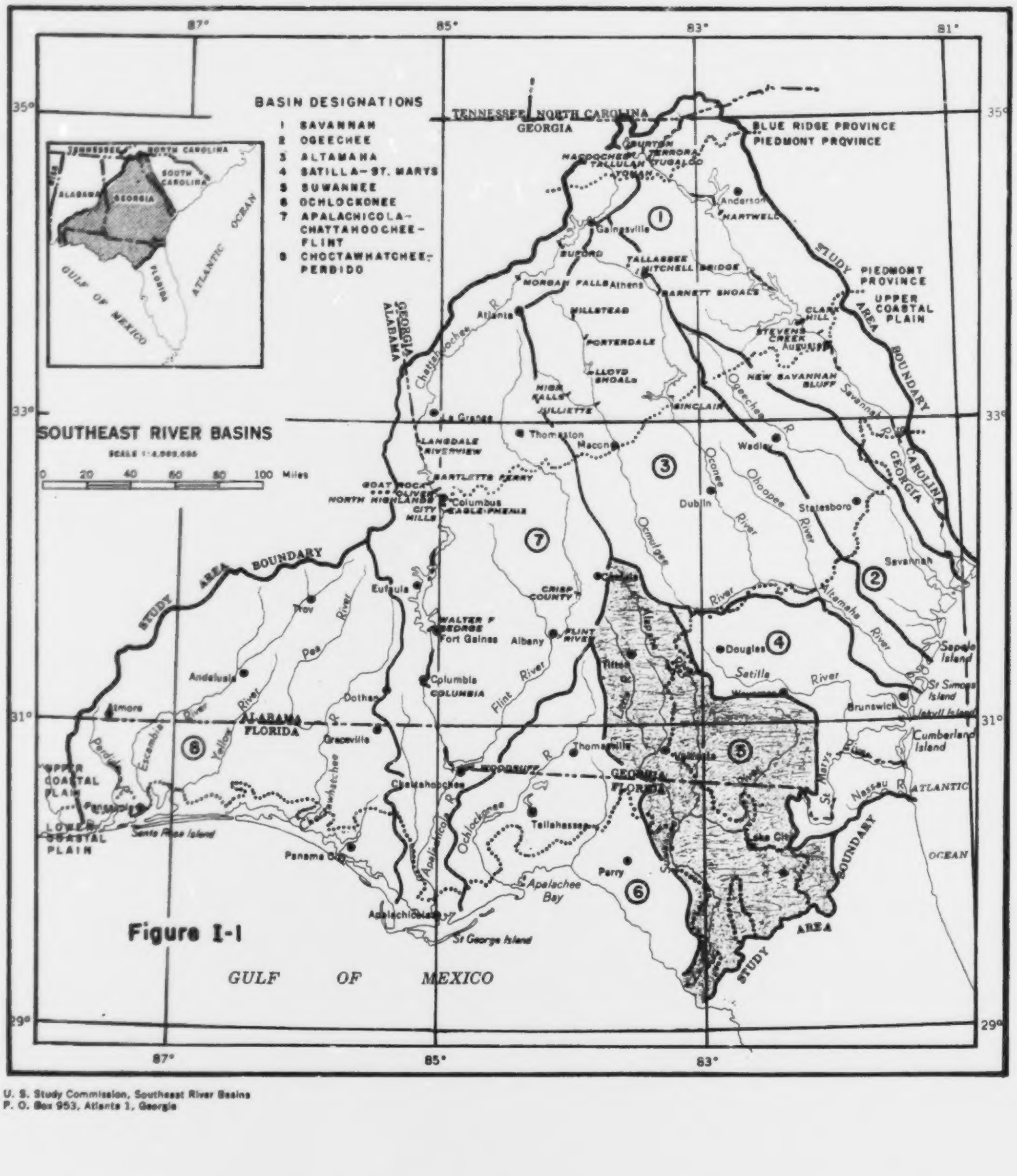

SOUTHEAST RIVER BASINS
0 20 40 60 80 100 Miles
BASIN DESIGNATIONS
1 SAVANNAH
2 OGEECHEE
3 ALTAMAHA
4 SATILLA-ST. MARYS
5 SUWANNEE
6 OCHLOCKONEE
7 APALACHICOLA-CHATTAHOOCHEE-FLINT
8 CHOCTAWHATCHEE-PERDIDO
STUDY AREA BOUNDARY
BLUE RIDGE PROVINCE
PIEDMONT PROVINCE
UPPER COASTAL PLAIN
LOWER COASTAL PLAIN
GULF OF MEXICO
ATLANTIC OCEAN

Figure I-1

U. S. Study Commission, Southeast River Basins
P. O. Box 953, Atlanta 1, Georgia

PREFACE

SCOPE

The U.S. Study Commission, Southeast River Basins, on December 30, 1959 and March 11, 1960, requested the assistance of the Public Health Service in:

(1) Formulating a domestic, municipal and industrial water supply plan, including pertinent economic studies,

(2) Formulating a water quality management plan including water pollution abatement and pertinent economic studies, and

(3) Formulating a plan for the protection of public health related to plans for the conservation, utilization, and development of land and water resources of the study area.

The Study Commission proposed that the Public Health Service compile the required basic data and prepare "single-purpose technical memoranda" on each of the above subjects and that these technical memoranda set forth the requirements for development to serve the above functions at present, in 1975, and 2000 in each of the eight river basins of the study area.

These memoranda on the Suwannee Basin have been prepared in fulfillment of the Commission's requests. They have been divided into three separate memoranda: MUNICIPAL, INDUSTRIAL, AND DOMESTIC WATER SUPPLIES; POLLUTION ABATEMENT; and PUBLIC HEALTH. In addition, a separate report has been prepared by the Public Health Service for the U.S. Study Commission: Water Quality Basic Data-Southeast River Basins, dated 1961. This report covers the Suwannee Basin as well as the seven other Basins within the U.S. Study Commission study area.

(in report)

The purpose of these memoranda is to provide data and information to the U.S. Study Commission-SERB on the present and projected status of water supply, pollution abatement, and public health facilities and programs for use in the preparation of a comprehensive plan for the conservation, utilization, and development of the land and water resources of the Suwannee Basin.

AUTHORITY

The Study Commission's requests are in partial fulfillment of its obligation under Public Law 85-850 which states in part: "In carrying out the purpose of this Act it shall be the policy of Congress to utilize the services, studies, surveys, and continuing in-

(6/1/62)

vestigational programs of the departments, bureaus, and agencies of the United States". The Act also states that the Commission may "secure directly from any executive department, bureau, agency, commission, office, independent establishment, or instrumentality, information, suggestions, estimates, and statistics for the purpose of this Act, and each such department, bureau, agency, board, commission, office establishment, or instrumentality is authorized to furnish such information, suggestions, estimates and statistics directly to the Commission, upon request by the Chairman or Vice Chairman".

The authority for the Public Health Service to undertake this study and the preparation and submission of these technical memoranda stems from the above and from the Public Health Service Act of 1944 (Public Law 410, 78th Congress) and its amendments; the Federal Water Pollution Control Act (Public Law 660, 84th Congress), and its amendments; Federal legislation on air pollution (Public Law 159, 84th Congress), with amendments; related miscellaneous provisions of other statutes; and the Public Health Service Regulations.

Public Law 85-850, under which the U.S. Study Commission operates, provides for investigations and studies and the preparation of a comprehensive and coordinated plan for the conservation, utilization, and development of land and water resources in the study area. In this plan formulation, the law specified, among other things, the inclusion of plans for:

(1) domestic and municipal supplies;

(2) possibilities of industrial development and utilization;

(3) pollution abatement and the protection of public health; and

(4) other beneficial and useful purposes.

ECONOMIC BASIS FOR PLANNING

Projections for 1975 and 2000 in this report were made using estimates of economic development furnished to the Public Health Service by the U.S. Study Commission, Southeast River Basins. The pattern of the future economy stems mainly from projections of population, employment, and income furnished by the Commission. The basic aggregate projections for these three components are considered by the Commission to be relatively firm. The breakdown of the basic projections into their different components and the derivation of data for river basins is based, in some cases, on limited information. The Commission emphasizes that these are preliminary estimates and that the pattern of the projected economy should not be taken as a rigid goal but should be considered flexible and subject to modification and refinement as the results of future studies become available.

RESPONSIBILITIES

The basic responsibility for the administration of Federal programs in municipal water supply, pollution control, and public health is vested in the Public Health Service. State programs and responsibilities are administered by the State health departments and water pollution control agencies. In the administration of these Federal and State programs, cooperation and assistance of other agencies with interests in these fields are obtained. The responsibilities and interests of all Federal, State, and local agencies in municipal water supply pollution control and public health programs in the Suwannee Basin are enumerated below.

PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

The Public Health Service serves in a consulting capacity to other Federal agencies and to the State and local health departments on matters relating to water supply, water pollution control, vector control, and other matters related to public health; makes investigations and studies; does scientific research in the above fields; collects vital statistics; and operates certain medical care and quarantine programs. In protecting the public health, the Service is responsible for developing and recommending procedures for the prevention and control of mosquitoes and other vectors associated with Federal water development projects.

As part of its responsibilities under the Federal Water Pollution Control Act (Public Law 660, 84th Congress) as amended, the Service is required to prepare or develop in cooperation with other Federal agencies, State and interstate water pollution control agencies, municipalities and industries, comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof and improving the sanitary conditions of surface and underground waters. In the development of such comprehensive programs, due regard is given to the improvements which are necessary to conserve such waters for public water supplies; propagation of fish and aquatic life and wildlife; recreational purposes; and agricultural, industrial, and other legitimate uses. The Service is further authorized to advise any Federal construction agency concerning the inclusion of storage in any proposed reservoir for regulations of stream flow for the purpose of water quality control.

The Public Health Service is authorized to make joint investigations, with any such agencies, of the condition of any waters in any State or States, and of the discharge of any sewage, industrial wastes, or substance which may adversely affect such waters. Section

8 (a) of Public Law 660 states that "The pollution of interstate or navigable waters in or adjacent to any State or States (whether the matter causing or contributing to such pollution is discharged directly into such waters or reaches such waters after discharge into a tributary of such waters), which endangers the health or welfare of any persons shall be subject to abatement as provided in this Act."

The Public Health Service works closely with State agencies and makes investigations and studies relating to health and pollution control aspects of development programs pertaining to municipal, industrial, and domestic water supplies. The Service also has the responsibility of collecting and disseminating basic data on radiological, chemical, physical, and biological water quality and other information insofar as such data and information relate to water pollution and the prevention and control thereof.

CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY

The Corps of Engineers operates the Federal program for the improvement and maintenance of rivers and other waterways in the interest of navigation and flood control. Water conservation and other water use functions beneficial to the public are considered in carrying out investigations and construction of water projects. Health matters relating to these projects include vector control, sanitation of work camps, recreation, water supplies, and water pollution abatement.

SOIL CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE

The Soil Conservation Service, under Public Law 566, 83rd Congress, as amended, prepares watershed work plans for small watersheds to assure water-flow retardation and soil erosion prevention. In the development of these work plans, consideration is given to water use functions beneficial to the people of the area, including irrigation, stock watering, and fish and wildlife propagation and municipal and industrial water supply. Control of insects around the watershed and use of water for domestic purposes are also given consideration.

FOREST SERVICE, DEPARTMENT OF AGRICULTURE

The Forest Service is responsible for the development and management of National Forests to preserve and increase the multiple benefits from these natural resources. Good forest management retards rapid runoff and prevents soil erosion, thus reducing pollution from natural sources. Sanitation of public facilities in National Forests is under the supervision of the Forest Service and privately operated facilities are regulated by use permits issued by the Service. It is to be noted, however, that Section 480, Title 16, U.S. Code states that jurisdiction over persons within National Forests should not be affected by the reason of these forests' existence. Thus, health and sanitation in National Forests is of concern to State and local health authorities.

GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

The Geological Survey is primarily a fact finding and research agency. It collects, analyzes, and interprets basic data on water, mineral, and land resources, and prepares topographic and geological maps and reports as a prerequisite to planning, constructing, and operating projects for the development and utilization of these natural resources.

NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR

The National Park Service administers programs for the National Parks, monuments, historic sites, and similar areas. It has the responsibility for maintaining sanitary and healthful conditions in these areas. The Service cooperates with other agencies in investigating the recreational possibilities at proposed reservoir projects and in planning for their protection, development, and utilization.

ATOMIC ENERGY COMMISSION

The Atomic Energy Act of 1954 authorizes the Atomic Energy Commission to regulate the use of certain radioactive materials and certain facilities, which produce or use these materials, to protect against hazards to life or property. A National Committee on Radiation Protection, comprised of members of serveral Federal agencies including the Public Health Service and professional organizations, prepares recommendations on protection from radioactive substances.

FLORIDA STATE BOARD OF HEALTH

Rules and regulations for the betterment and protection of the public health of the State of Florida are included in the State's Sanitary Code (Chapter 381, Florida Statutes). The adoption, promulgation, and enforcement of this Code is the responsibility of the Florida State Board of Health. Among the 35 chapters of the Sanitary Code relating to the public health engineering and sanitation program of the State, there are included rules and regulations governing public water supplies, public sewerage systems, pollution of streams and waters, swimming pools and bathing beaches, impoundments, and private water supply wells.

Other statutes which are administered by the State Board of Health are the Tourist Camp Law (Chapter 513, Florida Statutes); The Nuisance Law (Chapter 386, Florida Statutes); Supervision by the State Board of Health over Pollution of All Underground and Surface Waters in the State and Over Water Supplies, Sewerage Systems, Sewage Waste and Refuse Disposal Systems in the State (Chapter 381 and Chapter 387, Florida Statutes); Pollution of Waters (Chapter 387, Florida Statutes); the Swimming Pool Law (Chapter 514, Florida Statutes); and the Air Pollution Control Act (Chapter 403, Florida Statutes 1957).

The Board has the authority to issue permits and review plans and specifications for the installation, alteration or extension of a water supply or sewerage system, and refuse or sewage disposal facilities to serve more than 25 people. The Board is further authorized to enforce any provisions of the Sanitary Code; conduct experiments relating to the purification of water and treatment of sewage, waste or refuse; consult with and advise counties, municipalities and other persons as to source of water supply, methods of water purification, and disposal of drainage, sewage or refuse; to establish water purity standards for the streams of the State; and to control air pollution in accordance with rules and regulations adopted by the State Air Pollution Control Commission.

LOCAL HEALTH DEPARTMENTS (FLORIDA)

In Florida, local health departments are organized on a county, multicounty, or city-county basis. Health officers in charge of these local units are deputized agents of the State Health Officer for the purpose of carrying out the provisions of the Sanitary Code of the State. Local health departments have the power to enforce rules, regulations, orders, and ordinances regarding the public health in accordance with the State laws. Local health departments also have the power to make sanitary inspections and isolate, quarantine, and abate nuisances.

FLORIDA BOARD OF CONSERVATION

The State Board of Conservation, through its Department of Water Resources, advises the Florida State Cabinet on measures to conserve and promote wider use of water resources; advises and coordinates the efforts of local agencies, water control authorities, municipalities, and counties-and individuals to achieve improved conservation, control, and use; and conducts an educational program to inform the public of sound state water resource policies and procedures.

FLORIDA GAME AND FRESH WATER FISH COMMISSION

The State Game and Fresh Water Fish Commission collects and compiles data of a biological and economic nature and recommends measures to mitigate losses or increases in the value of various water control structures to wildlife. The Commission also represents fish and wildlife interests in the planning of water resource projects.

FLORIDA GEOLOGICAL SURVEY

This Agency collects and compiles basic hydrological data on water resources of the State; locates uncontrolled flowing artesian wells and through the Water Resources Department cooperates with the U.S. Geological Survey on water surveys.

(6/1/62)

GEORGIA DEPARTMENT OF PUBLIC HEALTH

The State has retained all responsibilities and duties for the health of the public not otherwise granted to the Federal government in the Federal Constitution or by Acts of Congress. The State operates under the police power, inherent in the sovereign State to enact and enforce laws to protect and promote the health, safety, morals, order, peace, comfort, and general welfare of the people. Among the powers of the State Board of Health are the following:

1. Adopt rules, regulations, and orders.
2. Enforce State laws, regulations, and orders.
3. Isolate and quarantine, make sanitary investigations and inspections, and collect vital statistics.
4. Review plans and specifications for any new municipal water systems to be installed, or changes to be made in any existing system by any city, corporation, partnership, or individual.
5. Inspect the source of municipal water supply, and to determine if the water is impure and dangerous to individuals or to the public generally.
6. Act in a consultative capacity to local agencies.
7. Approve and regulate the impounding of waters as they affect insect and vector control.

The Georgia Water Quality Act (Laws of Georgia, 1957, Act No. 491) provides for the control of water quality within the State and the regulation of public water supply treatment facilities. It prohibits the discharge of sewage, industrial wastes, or other wastes into the waters of the State which would adversely affect the health of the people or render such waters unsuitable for their then current uses, and provides for the treatment of such wastes. It provides for the issuance of certificates to persons discharging or permitting to be discharged into the waters of the State any sewage, industrial wastes, or other wastes.

The Act declares it to be the policy of the State of Georgia that the water resources of the State shall be utilized prudently to the maximum benefit of the people without so impairing the quality of the water resources as to jeopardize public water supplies and public health, and without interfering unreasonably with beneficial use of the water resources for recreation, fish and wildlife development, agriculture, and the industrial development of the State's natural resources and its manpower. The State water pollution control agency (State Board of Health) is charged with the responsibility, and has the authority to require the use of reasonable methods to prevent and control the pollution of the waters of the State.

The State Board of Health under the Water Quality Act, has the responsibility and power to, as it deems necessary, establish such standards of quality for any waters in relation to the reasonable and proper use thereof, and such general policies and standards relating to any existing or future pollution of such waters. The State Board of Health has the power to issue orders directing any particular person or persons to secure within the time specified therein, such operating results as are reasonable and practicable of attainment toward the control, abatement, and prevention of pollution of the waters of the State and the preservation of the necessary quality for the reasonable use thereof.

The State Board of Health has the power to establish such policies, requirements, and/or standards governing the source, distribution, purification, treatment and storage of water for public or community water supply systems as it deems necessary for the reasonable and proper use thereof in conformity with the intent of the Water Quality Act. The Act states that it shall be unlawful for any person to erect, construct, enlarge, extend, open, reopen, or operate any public or community water supply system, including storage, distribution, purification treatment facilities or works, without having first secured from the Board approval of the source of water supply; the means and methods of treating, purifying and storing water; plans and specifications for the construction of facilities or works; and the operation thereof.

LOCAL HEALTH DEPARTMENTS (GEORGIA)

Georgia laws provide for the formation of county boards of health. These are created for the purpose of carrying out State rules, regulations, and orders as well as adopting other regulatory measures needed for protecting the public health within the local jurisdiction. Local Boards of Health in Georgia have the power to:

1. Adopt rules, regulations, and orders.
2. Enforce State laws, regulations, and orders.
3. Enforce local regulations and ordinances.
4. Make sanitary inspections and investigations, isolate, quarantine, and abate nuisances.

GEORGIA OIL AND GAS COMMISSION

The Georgia Oil and Gas Commission is authorized to make rules, regulations, and orders for the prevention of the pollution of fresh water supplies by oil, gas or salt water (1955 Cum. Supp., Title 43, Section 713).

GEORGIA GAME AND FISH COMMISSION

In the protection of fish and other aquatic life, the Georgia Game and Fish Commission is vitally interested in habitat waters. This agency cooperates with other State and Federal agencies in investigations and studies of water quality as related to fish and other aquatic life. This Agency enforces legislation against the use of explosives, poisonous substances, etc. for the purpose of catching, killing, taking or harming fish (1955 Cum. Supp., Title 45, Section 703).

GEORGIA WATER QUALITY COUNCIL

The Georgia Water Quality Council makes recommendations to the State Board of Health with regard to regulations, procedures, standards, waste disposal certificates, and policies governing public and community water supplies and waste disposal into waters of the State for controlling pollution and quality of such waters.

GEORGIA DEPARTMENT OF MINES, MINING, AND GEOLOGY

The Division of Conservation in this Department collects and compiles water resources data and cooperates with the U.S. Geological Survey, U.S. Soil Conservation Service, and State Soil Conservation Committee on surface and ground water surveys and chemical quality of waters.

GEORGIA RESOURCES COMMISSION

The Commission is responsible for inventorying the State's water resources and gathering such data as are necessary for determing what further legislation is needed with regard to quantitative control of the State's water resources. A State water engineer, appointed by the Commission is authorized to employ a water resources fact finding and research staff to be known as the Georgia State Water Survey.

WATER PURVEYORS

The general responsibility for the purity of water is shared by health authorities, water purveyors, owners of property, and water users. Those duties of health authorities and other agencies have been presented. The purveyor of water must safeguard it while in the water supply system, with some overlapping responsibilities with the property owner once the water reaches the property line. Regulations controlling the manufacturing, importing or bottling of water in the Basin are administered by the Florida and Georgia State Boards of Health.

DESCRIPTION OF THE BASIN

GENERAL

The Suwannee Basin is bounded on the northeast by the Ocmulgee and Satilla River Sub-basins, on the west by the St. Marys, St. Johns, and Withlacoochee River Sub-basins, on the south by the Gulf of Mexico, and on the east by the Ochlocknee Basin and Flint River Sub-basin.

The Suwannee Basin lies entirely within the Coastal Plain Province and has a drainage area of 11,000 square miles. The Upper Coastal Plain portion of the Basin, characterized by gently rolling hills, the Okefenokee Swamp, and the gently sloping Lower Coastal Plain constitute the three principal land forms of the Basin. Two-thirds of the Basin has woodland cover, predominately pine with some bottomland hardwood. The rivers of the Basin carry a light sediment load, although the Okefenokee Swamp area contributes much solid and dissolved organic matter which causes the typical dark color of the water.

The Suwannee River rises in the Okefenokee Swamp in southeast Georgia and flows in a very meandering, southward direction to the Gulf of Mexico 12 miles north of Cedar Key, Florida. The principal tributaries of the Suwannee River are the Alapaha and Withlacoochee Rivers which rise in the Georgia portion of the Basin, and the Santa Fe River which rises at Lake Santa Fe near Gainesville, and is wholly within Florida. Both the Alapaha River and the Santa Fe River disappear into underlying limestone but reappear several miles farther downstream. The Suwannee River drains about 800 square miles of the Okefenokee Swamp. This natural reservoir area tends to smooth out short term fluctuations in the flow. Tidal effects extend up the Suwannee River about 15 miles. There are no major man-made reservoirs, diversions, hydroelectric plants, or other water resource projects in the Basin.

CLIMATE AND HYDROLOGY

The climate of the Basin is temperate with long summers and short, mild winters. The mean annual temperature ranges from 65°F in the northern portion to 72°F along the coast. The frost free growing season ranges from 250 days in the interior to 300 days along the coast. The average annual rainfall ranges from 44 inches in the upper portion of the Basin to 57 inches near the coast.

(6/1/62)

The stream flows vary greatly from year to year. The 18 year record (1931; 1942-58) of the Suwannee River at Wilcox where the drainage area is 9,500 square miles shows a 24-hour maximum discharge of 84,700 cfs, a minimum of 3,270 cfs and an average discharge of 9,887 cfs. There are no major tributaries entering the river below this gaging station which is located some 25 miles above the Gulf of Mexico. The flows contributed to the Suwannee River by its tributaries, in terms of daily average discharges, are as follows: Alapaha River, 908 cfs (at Statenville); Withlacoochee River, 1,445 cfs (at Pinetta); and Santa Fe River, 1,545 cfs (at Ft. White).

The Basin is underlain by the principal limestone aquifer. This aquifer is composed of the Ocala limestone of late Eocene Age, the Suwannee limestone of Oligocene Age, and the Tampa limestone of Miocene Age which generally act as a single hydrologic unit. The upper confining bed of low permeability is the Hawthorne formation and the lower confining bed consists of clay and limestone of the McBean formation.

In a large portion of the Basin in Florida, these limestone aquifers are at or near the ground surface. Consequently, there are numerous springs, sinks and underground passages. Much of the surface drainage collects in sinks with no visible outlet. There are two known areas of recharge of the aquifer in the Basin: one near Valdosta, Georgia, and another in an area extending from the Okefenokee Swamp southeast to Starke, Florida.

In the eastern portion of the Basin, municipal water supplies are obtained from the sand and limestone aquifers of the Miocene Age. The western edge of this formation begins near Nashville, Georgia, follows a line south to Valdosta, Georgia, and then southeast to Starke, Florida. In the remainder of the Basin, municipal ground water supplies are obtained from the principal limestone aquifer.

POPULATION

The population of the Suwannee Basin, according to census data provided by the U.S. Study Commission, was 287,200 in 1960. This represents a total decrease of 2,300 or about one percent since 1950. However the urban (municipalities of 2,500 or more) population increased from 83,600 to 114,400 or 37 percent during the 1950-60 decade while the rural decreased from 205,900 to 172,800 or 16.1 percent.

There are fifteen communities in the Basin which had populations greater than 2,500 in 1960. They are: Adel, 4,321; Ashburn, 3,291; Fitzgerald, 8,781; Homerville, 2,634; Moultrie, 15,764; Nashville, 4,070; Ocilla, 3,271; Quitman, 5,071; Sylvester, 3,610; Tifton, 9,903; and Valdosta, 30,652; in Georgia, and Lake City, 9,465; Live Oak, 6,544; Madison, 3,239; and Starke, 4,806; in Florida, thirteen other communities in the Basin have populations between 1,000 and 2,500.

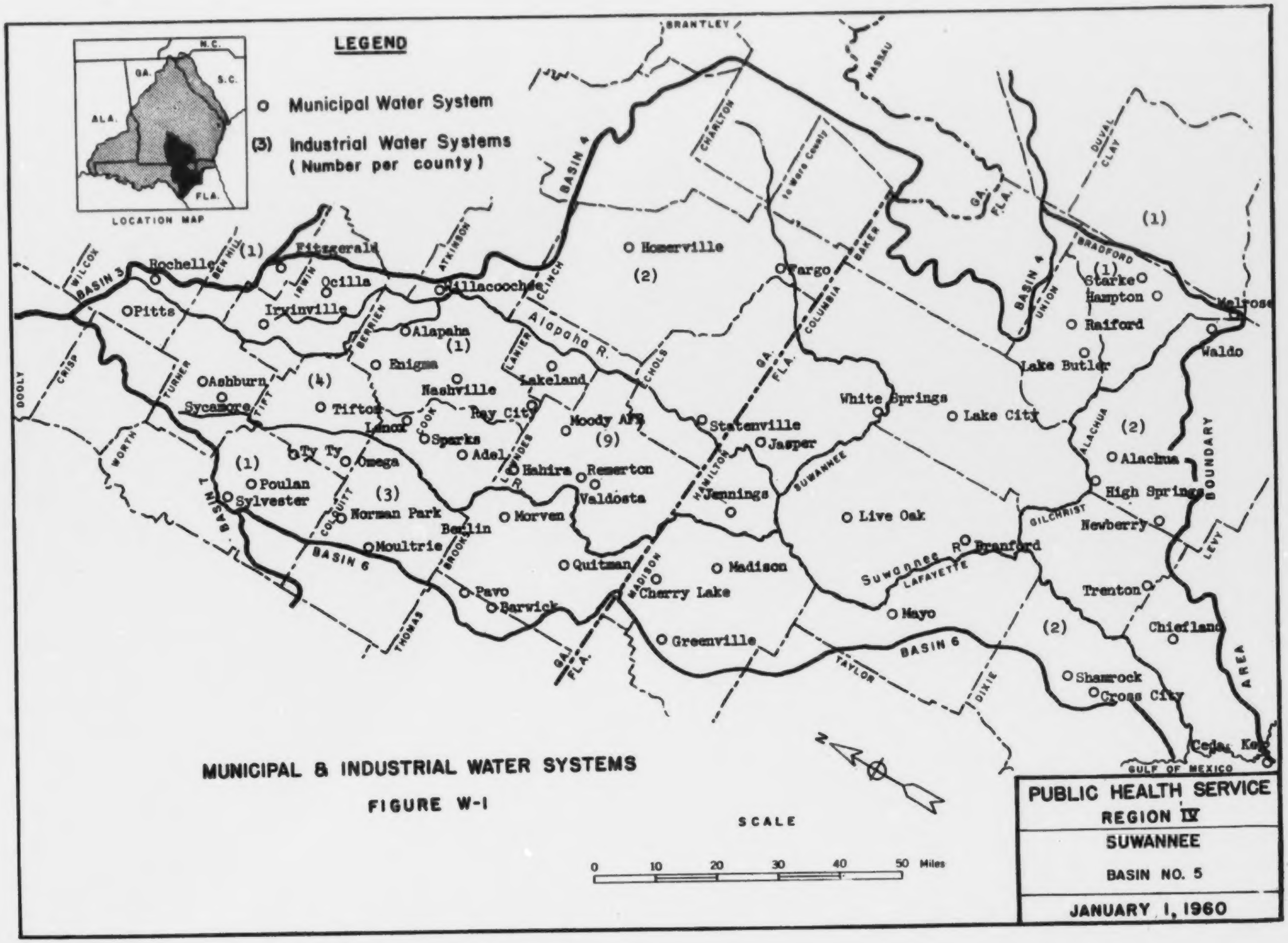
RESOURCES

The economy of the Basin is prodominantly agricultural. The number engaged in farming is nearly twice the number engaged in manufacturing. The leading income crops are tobacco, forestry products, corn, peanuts, cotton and commercial truck-crops. There are significant differences in the nature and extent of economic activities in the Georgia and Florida portions of the Basin. Although nearly half of the Basin lies in Florida, two-thirds of the agriculture employment and three-fourths of the manufacturing plants are in the Georgia portion.

Manufacturing activities center around the lumber and wood products industry. Other leading industries are apparel, metal, food processing, and textile. The major portion of the manufacturing activities is concentrated in or near the several larger towns of the Basin.

Navigation and boating in the Basin are hampered by the very shallow water at the mouth of the Suwannee River. Commercial navigation is confined to fishing craft in the coastal channels near Cedar Key, Florida. The streams, lakes, and springs of the Basin and the Okefenokee Swamp are used considerably for sport fishing, small craft boating and other recreational persuits. There are no beach areas along the Gulf of Mexico portion of the Basin.

MUNICIPAL, INDUSTRIAL AND DOMESTIC WATER SUPPLIES


LEGEND
○ Municipal Water System
(3) Industrial Water Systems (Number per county)
LOCATION MAP
N.C.
S.C.
GA.
ALA.
FLA.
BRANTLEY
NASSAU
CHARLTON
To Ware County
DUVAL
CLAY
BRADFORD
UNION
BAKER
COLUMBIA
GA. FLA.
BASIN 4
BASIN 3
BASIN 6
BASIN 7
WILCOX
DOOLY
CRISP
TURNER
WORTH
BEN HILL
IRWIN
TIFT
BERRIEN
ATKINSON
CLINCH
LANIER
COOK
ECHOLS
LOWNDES
COLQUITT
BROOKS
THOMAS
HAMILTON
SUWANNEE
MADISON
LAFAYETTE
GILCHRIST
ALACHUA
LEVY
DIXIE
TAYLOR
BOUNDARY
AREA
GULF OF MEXICO
Rochelle
Pitts
Fitzgerald
Ocilla
Irvinville
Willacoochee
Alapaha
Enigma
Nashville
Lakeland
Ray City
Lenox
Sparks
Adel
Ashburn
Sycamore
Tifton
Ty Ty
Omega
Poulan
Sylvester
Norman Park
Moultrie
Berlin
Morven
Hahira
Remerton
Valdosta
Moody AFB
Quitman
Pavo
Barwick
Homerville
Fargo
Statenville
Jasper
Jennings
White Springs
Lake City
Live Oak
Madison
Cherry Lake
Greenville
Mayo
Branford
Suwannee R.
Alapaha R.
Starke
Hampton
Raiford
Lake Butler
Melrose
Waldo
Alachua
High Springs
Newberry
Trenton
Chiefland
Shamrock
Cross City
Cedar Key
(1)
(1)
(4)
(1)
(3)
(2)
(9)
(2)
(1)
(1)
(2)
(2)
N
SCALE
0 10 20 30 40 50 Miles
PUBLIC HEALTH SERVICE
REGION IV
SUWANNEE
BASIN NO. 5
JANUARY 1, 1960

MUNICIPAL & INDUSTRIAL WATER SYSTEMS

FIGURE W-1

INTRODUCTION

SCOPE OF MEMORANDUM

This memorandum contains data and information concerning the present status of municipal, industrial, and domestic water supply systems whose source of water is in the Suwannee Basin. Although an attempt was made to collect data on semi-public water supplies, the amount of information available was not sufficient to warrant inclusion in this memorandum. Estimated future water requirements in the Basin for the years 1975 and 2000 are also presented, as are suggested solutions to present and anticipated future water supply inadequacies. In connection with these suggested solutions, an appraisal of the benefits to be derived and the annual costs of obtaining water are included.

This memorandum contains no data concerning water requirements of steam-electric generating stations located in the Basin.

PROCEDURES AND INVESTIGATIONS

Existing data on water demand and availability were obtained from reports, records, and correspondence of the Florida State Board of Health, the Florida State Chamber of Commerce, the Georgia Department of Public Health, the Georgia State Chamber of Commerce, the Georgia Department of Commerce, the U. S. Department of Agriculture, and other Federal and State agencies. Where data were found to be lacking or out-dated, extensive field investigations were conducted. These field investigations were conducted by the Florida State Board of Health, and the Georgia Department of Public Health. The data obtained were submitted to the Public Health Service for inclusion in this memorandum. The field investigations included visits to municipalities, small communities, industries, institutions, and a limited number of domestic water users.

Data were obtained regarding the 69 municipal water supply systems in the Basin and carefully studied to establish both present and future water requirements and water supply needs.

Data on industrial water use were obtained from the municipalities furnishing the water, or when an industrially-owned water supply system was involved, from the industry itself. The location of municipal and industrial water supply systems is shown by Figure W-1.

Little information was available concerning the large number of existing domestic water supply systems. Because limited time and funds would not permit a complete inventory of all domestic water systems, a random sample survey of approximately 500 systems throughout the SERB area was made. The data thus obtained were analyzed and certain conclusions were drawn regarding the average number of persons served by each system, the percentages of the various types of wells and equipment, and the extent of improvements needed. These SERB area averages were applied to the Suwannee Basin.

BASIC ASSUMPTIONS

Populations of individual municipalities have been projected to 1975 and 2000 using census data where available or estimated populations for communities not listed in census reports. Projections were made by applying the geometric progression method based on the rate of increase over the period 1930-1960, modified by considerations of changing economic conditions. However, the population projections of urban areas (municipalities of 2500 or more) were adjusted to match projections made by the U. S. Study Commission.

For purposes of this memorandum, future municipal water demands were determined using projected urbanized area populations and estimated per capita water use. The 1975 needs were determined using a water demand of 100 gallons per capita per day (gpcd) in municipalities of under 1,000 persons and 150 gpcd in municipalities of 1,000 or more. The 2000 projections were based on a water demand of 150 gpcd in municipalities of less than 1,000 persons and 200 gpcd in municipalities of 1,000 or more.

The number of domestic water users was estimated for 1960, 1975, and 2000. This number was determined by obtaining the difference between the population within the Basin served by municipal water systems and the total population of the Basin. Future domestic water demand was estimated by using 70 gpcd in 1975 and 100 gpcd for 2000. A figure of 4.5 persons per system was used to determine the number of domestic water supply systems. All future systems were assumed to be pressurized.

Projections of industrial water system demands (for those industries receiving all or a portion of their supply from industrially-owned systems) were determined by assuming that water demands will increase or decrease in direct proportion to projected industrial growth or decline. In addition, two new industries are expected to locate in the Basin.

January 1, 1960 constant dollars were used for the purpose of estimating annual capital costs, annual operation and maintenance costs, and annual replacement costs of existing and needed water supply systems. An interest rate of 4¼ percent was used for determining annual costs for municipal, domestic, and industrial water supply systems.

Water supply system costs have been estimated on the basis of per capita cost data developed by the Public Health Service and adjusted to the January 1, 1960 Engineering News-Record Construction Cost Index for Atlanta, Georgia.

QUANTITY AND QUALITY OF WATER AVAILABLE FOR WATER SUPPLIES

SURFACE WATER

A description of the major streams in the Basin has been included in the INTRODUCTION of these memoranda. Availability of data on quality of surface water in the Suwannee Basin was somewhat limited, especially in Georgia. Thirteen chemical quality stations reported analyses results - four of these were for streams and nine for springs in Florida.

The report, Water Quality Basic Data - Southeast River Basins, 1961, prepared for the U. S. Study Commission by the Public Health Service, shows a range in total dissolved solids content on the Alapaha River of 35 to 45 parts per million (ppm). Hardness on this stream was approximately 8 ppm. In contrast, the average total dissolved solids on the Suwannee River ranged from 150 to 194 ppm and average hardness from 121 to 175 ppm. Iron content on streams varied from 0.0 to 0.36 ppm. Total dissolved solids for spring waters ranged from 147 to 1207 ppm, hardness from 134 to 402 ppm, and iron generally from 0.02 to 0.22 ppm.

To supplement existing surface water quality data, four sampling stations were established in the Basin by the Public Health Service - two on the Alapaha River near Willacoochee and at Statenville, Georgia; one on the Little River near Adel, Georgia; and one on the Withlacoochee near Pinetta, Florida. Samples were collected during November 1960, January and February 1961, and June 1961. Average dissolved oxygen content at the first three stations varied from 65 to 77 percent of saturation, and median coliform varied from 410 to 4600 MPN per 100 ml at all stations. Color values at all stations were high. The lowest dissolved oxygen content was reported at the Pinetta station where the values ranged from 53 to 55 percent of saturation.

At the present time, the surface waters of the Basin are not used for municipal or domestic water supplies, probably due to the abundance of high quality ground water and to the high color content of the surface waters. Color is not readily removed by conventional treatment.

GROUND WATER

Available ground water in the Suwannee Basin is plentiful due to the high productivity of the principal limestone aquifer which underlies the area. The depth of the aquifer is usually found to be less than 100 feet, and its thickness varies from 100 to 150 feet. There are many large springs and wells in the aquifer which yield several thousand gallons per minute.

(6/1/62)

Chemical quality data for ground water were available at 33 stations, only 7 of which were in Georgia. Average concentrations of hardness ranged from 80 to 440 ppm with practically all of the 33 sampling stations having hardness in excess of 125 ppm. Eleven stations had average iron concentrations in excess of 0.3 ppm (maximum reported was 2.27 ppm). The concentration of sulfates varied considerably. One station reported an average concentration in excess of 250 ppm. The average concentration of total dissolved solids ranged from 109 ppm to 1791 ppm, with four stations having an average concentration in excess of 250 ppm. The average concentration of total dissolved solids ranged from 109 ppm to 1791 ppm, with four stations having an average concentration inexcess of 500 ppm.

Relatively high concentration of chlorides (up to 995 ppm) at Cedar Key, Florida indicates a salt water intrusion problem. A few occurrences of bacterially contaminated wells have been reported in Florida and the high concentration of silica in some wells would detrimentally affect boilers whose pressure exceeds 150 pounds per square inch.

The quality of the ground water in the Suwannee Basin is such that treatment for the removal of iron, and/or reduction of hardness is required at many locations to meet the chemical quality limits of the Public Health Service "Drinking Water Standards".

MUNICIPAL WATER SUPPLIES

INVENTORY

As shown by Table W-1, there are 69 municipal water systems whose source of water is within the Suwannee Basin. These systems serve 168,796 persons in 69 communities and institutions. The total population of the Suwannee Basin in 1960 was 287,200. All of the water systems use ground water as the source of their supplies.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

The average water demand of the 69 municipal systems shown in Table W-1 is 16.820 mgd or 99 gpcd. Industries which depend on municipal systems for water supply consume 1.8 mgd or 10.6 percent of the total municipal system output.

Fifteen of the municipal water supply systems are privately owned and 54 are publicly owned. All plants have periodic bacteriological examinations made of the water supplied to the public. Nine systems aerate their supplies, 4 have softening, 20 provide simple chlorination, 34 have no treatment (the supplies have proven bacteriologically satisfactory up to the present time without disinfection), and the remainder have chlorination and chemical addition, filtration only, or other combinations. Fitzgerald and Valdosta, Georgia, serving 41,570 persons provide flouridation.

Four municipalities in Florida reported difficult treatment problems. Lake Butler reported problems with iron and excess hydrogen sulfide. Mayo reported problems with iron and corrosion; and, Greenville and Madison reported difficulty with iron removal.

WATER SUPPLY SYSTEM REQUIREMENTS FOR 1960

Although 30 municipalities reported that improvements to their present water supply systems were needed, a study of the basic data indicates that 55 of the water supply systems have source, treatment, storage, or distribution system inadequacies.

The recommended improvements as shown by Table W-2 in terms of costs, include wells for 20 communities, disinfection for 38, iron removal for 10, storage facilities for 15, high service pumps for 1, softening for 2, and distribution system extensions serving approximately 5,000 additional persons in 27 communities.

FUTURE WATER SUPPLY SYSTEM REQUIREMENTS

Table W-3 shows the projected municipal water demands for 1975. It is anticipated that most subidivisions shown in the 1960 inventory and the small systems at Ashburn and Ray City, Georgia will have been incorporated into adjacent cities by 1975. The 69 municipal water systems expected to exist in 1975 will have an estimated total water demand of 32.98 mgd and will serve an estimated 217,271 persons. Water supply system improvements in addition to those listed as being needed in 1960 will be required to adequately serve this population. A study of the basic data indicates that wells will be required in 7 municipalities, disinfection equipment in 6, treatment plant construction (new or additions to existing facilities) in 2, elevated storage in 32 and expansion of distribution systems to serve an estimated 41,250 persons in 61 communities.

Table W-4 shows the projected municipal water demands for the year 2000. By the year 2000 the 75 municipal water systems expected to exist will serve an estimated 317,391 persons, and the total water demand is estimated to be 63.56 mgd. Basic data studies indicate that improvements in addition to those listed as being needed in 1975 will be wells for 26 systems, disinfection equipment in 17, new treatment plant construction or addition in 11, elevated storage in 62, and expansion of distribution systems to serve an estimated 100,800 persons in 68 communities.

FUTURE WATER SUPPLY PROBLEMS

There appears to be ample ground water in the Suwannee Basin for anticipated future needs. Water is available near points of use and no special impoundments or transportation facilities will be required to supplement sources of supply. Water quality is generally satisfactory, and extensive treatment is necessary for only a few systems. Cedar Key, Florida will probably obtain its water from a inland source in the future because of the salt water intrusion problem.

ANNUAL COSTS

The annual cost of providing water to municipal users in the Suwannee Basin in 1960 is estimated to be $1,561,000. This cost, based on the cost of existing facilities, is broken down as follows:

Annual equivalent capital cost	$ 795,700
Annual replacement cost	36,100
Annual operation and maintenance cost	729,000
Total annual cost (1960)	$1,561,000

The total capital outlay required to improve the existing municipal water supply facilities in 1960 is estimated to be $2,171,000 as shown by Table W-2. The expenditure of this amount of money will strengthen the existing municipal water systems of the Basin and provide adequate service.

Between 1960 and 1975, additional expenditure will be necessary to improve water supply systems and meet the demands of the increased number of users. The capital cost of providing the additional necessary improvements by 1975 is estimated to be $4,456,000 as shown by Table W-3. This includes $541,000 for improvement of sources and treatment, $1,440,000 for storage facilities, and $2,475,000 for distribution facilities.

The annual cost of providing water to municipal users in 1975 is estimated to be $2,700,000. This includes annual equivalent capital cost of: (1) existing facilities in 1960, (2) facilities recommended to meet 1960 needs, and (3) facilities recommended to meet additional needs between 1960 and 1975. The replacement cost is based on total investment as of 1975, and the operation and maintenance cost is based on the total installed systems as of 1975. A breakdown of this annual cost is given below.

Annual equivalent capital cost	$1,118,000
Annual replacement cost	59,000
Annual operation and maintenance cost	1,523,000
Total annual cost (1975)	$2,700,000

Between 1975 and 2000, municipal growth will make necessary an additional estimated capital expenditure of $11,333,000 to raise the water supply facilities to the necessary capacity. This includes $1,501,000 for source improvement and treatment facilities, $3,784,000 for storage capacity, and $6,048,000 for extension of distribution facilities.

(6/1/62)

TABLE W-1
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SUWANNEE BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
FLORIDA									
Alachua	1974	2075	wells	none	1.008	0.063	0.180	87	
Branford	663	690	wells	H-FzDh	0.410	0.040	0.100	145	
Cedar Key	668	350	wells	Dc	0.126	0.060	0.050	142	
Cherry Lake (unincorp)	330	350	wells	none	0.185	0.011	0.040	114	
Chiefland	1459	1460	well	Dh	0.216	0.050	0.120	82	
Cross City	1857	1985	wells	I-AcCalFrsDc	1.130	0.179	0.300	150	5
U. S. Radar Station	--	61	wells	I-FpsDh	0.228	0.120	0.032	525	
Greenville	1318	1330	wells	none	0.691	0.050	0.160	120	
Hampton	340	360	well	none	0.158	0.008	0.037	103	
High Springs	2329	2350	wells	H-CaltMtpsSv-KcFarDc	0.590	0.135	0.246	105	
Jasper	2103	2140	wells	Dc	1.660	0.308	0.250	117	2
Jennings	516	500	well	Dh	0.144	0.020	0.050	100	3
Keystone Club Estates	--	100	well	Dc	0.260	none	0.100	1000[1]	
Lake Butler	1311	800	wells	--[2]	1.368	0.100	0.080	100	1
Lake City	9465	9760	wells	AtDc	3.456	0.600	1.000	103	
Forest Ranger School	--	130	wells	Dc	1.080	0.500	0.015	115	
Live Oak	6544	5760	wells	H-AtCalMtps-SvFrsDc	1.800	0.545	0.700	122	10
Madison	3239	3410	wells	none	1.440	0.350	0.400	117	5
Conway Quarters	--	200	well	none	0.014	none	0.020	100	
Mayo	687	670	wells	AtKcDc	0.331	0.100	0.080	120	
Melrose (unincorp)	630	150	well	Dh	0.432	0.003	0.015	100	
Newberry	1105	1060	wells	Dc	1.944	0.060	0.150	142	
Raiford State Prison	--	3500	well	Dc	3.600	0.200	0.800	228	
Shamrock (unincorp)	650	350	well	Fs	0.100	0.050	0.050	143	
Starke	4806	4800	wells	Dc	2.880	0.550	1.000	208	
Trenton	941	950	wells	KpDc	1.037	0.030	0.125	132	5
Waldo	735	570	wells	Dh	0.256	0.015	0.100	176	
White Springs	633	670	well	AcScDc	0.720	0.175	0.090	135	
Stephen Foster Park	--	undet	wells	AtKpDh	0.216	0.013	0.025	--	

(6/1/62)

TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SUWANNEE BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
GEORGIA									
Adel	4321	4360	wells	none	4.320	0.100	0.400	92	50
Alapaha	631	655	well	none	0.144	0.040	0.043	65	20
Ashburn #1	3291	3750	wells	Dc	2.300	0.175	0.250	63	33
#2	--	180	well	none	0.015	undet	0.001	55	
Barwick	400	400	wells	Dh	0.216	0.030	0.025	63	
Berlin	419	445	well	none	0.216	0.075	0.015	36	
Enigma	525	525	well	Dc	0.172	0.060	0.025	47	
Fargo (unincorp)	--	1200	well	none	0.072	0.050	0.050	42	20
Fitzgerald	8781	10,520	wells	DcVt	4.320	1.000	1.140	108	6
Hahira	1297	1300	wells	none	0.390	0.100	0.075	58	
Homerville	2634	2620	wells	none	0.576	undet	0.130	50	
Irwinville (unincorp)	200	150	wells	none	undet	0.015	0.014	94	
Lakeland	2236	2280	wells	none	1.080	0.025	0.100	44	
Lenox	802	785	wells	none	0.720	0.050	0.060	76	
Moody AFB	--	2300	wells	AKcDc	2.160	0.700	0.750	330	
Morven	476	400	well	none	undet	0.020	0.020	50	
Moultrie	15,764	17,765	wells	Dc	5.760	1.400	1.700	96	35
Spence AFB	--	500	wells	Dc	1.000	0.525	0.300	600	
Nashville	4070	4125	wells	Dc	1.152	1.140	0.400	97	
Norman Park	891	890	wells	none	0.400	0.040	0.035	39	
Ocilla	3271	3270	wells	none	2.500	0.090	0.300	92	6
Omega	940	980	wells	none	0.500	0.060	0.060	61	
Pavo	817	800	wells	none	0.170	0.060	0.033	41	
Pitts	388	400	well	none	0.065	0.060	0.012	30	
Poulan	736	750	well	none	undet	0.040	0.060	80	2
Quitman	5071	5170	wells	none	3.160	0.150	0.350	67	11
Ray City #1	713	600	wells	Dh	0.432	0.020	0.030	50	
#2	--	50	well	none	undet	0.001	0.005	100	
Remerton	571	570	well	Dc	0.216	undet	0.050	88	48
Rochelle	1235	1255	wells	none	0.720	0.050	0.084	67	
Sparks	1158	1160	wells	none	0.578	0.050	0.060	52	
Statenville	475	180	wells	none	0.260	undet	0.009	50	
Sycamore	501	550	well	none	0.180	0.060	0.025	45	

(6/1/62)

TABLE W-1 (CONT'D)
BASIC DATA ON MUNICIPAL WATER SUPPLY SYSTEMS
SUWANNEE BASIN

Municipality	1960 Population	Estimated Population Served	Source	Treatment	Design Capacity mgd	Storage mg	Average Demand mgd	Average Demand gpcd	Percent Used by Industry
GEORGIA - Cont'd									
Sylvester	3610	3710	wells	Dc	1.440	1.000	0.300	81	5
Tifton	9903	13,850	wells	ADc	5.000	0.700	2.000	144	30
Abraham Baldwin College	--	550	wells	none	0.170	0.040	0.030	55	
Twin Lakes (unincorp)	230	500	well	none	0.250	0.020	0.025	50	
Ty Ty	461	460	well	none	0.144	0.010	0.014	30	
Valdosta	30,652	31,050	wells	ADcClMbSbKpVt	6.000	1.900	1.425	46	
Willacoochee	1061	1060	well	Dh	0.578	0.060	0.100	96	5
Totals		168,796					16.820	99	10.6

(6/1/62)

TABLE W-2
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1960
SUWANNEE BASIN

Municipality	Estimated Costs in $1,000				
	Source	Treatment	Storage	Dist. System	Total
FLORIDA					
Alachua	--	10	--	--	10
Cedar Key	12	8	--	44	64
Cherry Lake	--	6	--	--	6
Chiefland	12	2	--	--	14
Cross City	--	--	58	4	62
Greenville	--	15	--	--	15
Hampton	12	4	--	--	16
High Springs	--	38	70	16	124
Jasper	6	15	--	78	109
Jennings	12	4	--	3	19
Keystone Club S/D	--	--	27	--	27
Lake Butler	--	65	--	31	96
Lake City	--	106	48	41	195
Forest Ranger School	--	--	18	--	18
Lawtey	12	2	29	37	80
Live Oak	--	--	--	69	69
Madison	12	12	--	--	24
Mayo	--	--	--	2	2
Melrose	12	2	27	29	70
Newberry	--	--	--	6	6
Shamrock	12	4	--	18	34
Starke	--	2	--	--	2
Trenton	--	2	48	10	60
Waldo	--	--	22	10	32
White Springs	12	--	2	--	14
GEORGIA					
Adel	--	8	35	--	43
Alapaha	12	4	--	--	16
Barwick	--	--	--	13	13
Berlin	12	4	--	--	16
Enigma	12	2	--	--	14
Fargo	12	8	--	--	20
Fitzgerald	--	--	90	--	90
Hahira	--	8	--	1	9
Homerville	--	8	--	41	49
Irwinville	--	2	--	3	5
Lakeland	--	8	--	--	8
Lenox	--	2	--	10	12
Morven	12	4	--	5	21

TABLE W-2 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1960
SUWANNEE BASIN

	Estimated Costs in $1,000				
Municipality	Source	Treatment	Storage	Dist. System	Total
GEORGIA - Cont'd					
Norman Park	--	8	--	--	8
Ocilla	--	8	35	--	43
Omega	--	4	--	--	4
Pavo	--	2	--	--	2
Pitts	12	4	--	7	23
Poulan	12	4	--	--	16
Quitman	--	8	--	--	8
Ray City	--	2	--	4	6
Rochelle	--	8	--	39	47
Sparks	--	8	--	31	39
Statenville	--	4	25	18	47
Sycamore	12	4	--	98	114
Tifton	--	--	--	--	--
Abraham Baldwin College	--	4	--	--	4
Twin Lakes	--	2	--	--	2
Ty Ty	12	4	--	--	16
Valdosta	24	--	272	--	296
Willacoochee	12	10	--	--	22
Totals	258	439	806	668	2171

---

* Based on January 1, 1960 constant dollars.

(6/1/62)

TABLE W-3
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000 Source and Treatment	Storage	Dist. System	Total
FLORIDA						
Alachua	2450	0.367	--	38	22	60
Branford	1000	0.150	--	--	19	19
Cedar Key	500	0.071	--	--	--	--
Cherry Lake	500	0.057	--	29	9	38
Chiefland	1950	0.291	--	35	29	64
Cross City	2000	0.300	--	--	1	1
U. S. Radar Station	61	0.032	--	--	--	--
Fort White	600	0.060	28	25	36	89
Greenville	1800	0.270	--	35	28	63
Hampton	550	0.055	--	18	11	29
High Springs	2500	0.375	--	--	9	9
Jasper	2350	0.350	--	38	13	51
Jennings	800	0.080	--	--	15	15
Keystone Club S/D	100	0.100	--	--	--	--
Lake Butler	1750	0.260	--	--	26	26
Lake City	12,000	1.800	--	82	93	175
Forest Ranger School	130	0.015	--	--	--	--
Lawtey	900	0.090	14	--	17	31
Live Oak	8000	1.200	--	58	87	145
Madison	3600	0.540	2	--	12	14

(6/1/62)

TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
FLORIDA - Cont'd						
Mayo	900	0.108	--	--	12	12
Melrose	850	0.085	--	--	13	13
Newberry	1450	0.217	--	--	18	18
Olustee	650	0.065	28	27	39	94
Raiford State Prison	5000	1.140	--	70	10	80
Raiford	710	0.071	28	27	43	98
Shamrock	850	0.122	--	--	12	12
Starke	5500	1.000	2	--	42	44
Trenton	1200	0.180	--	--	15	15
Waldo	900	0.157	--	27	10	37
Wellborn	700	0.070	28	27	42	97
White Springs	1050	0.157	--	--	23	23
Stephen Foster Park	--	0.025	--	--	--	--
GEORGIA						
Adel	5400	0.810	--	48	62	110
Alapaha	800	0.080	--	--	9	9
Ashburn	4300	0.645	--	58	10	68
Barwick	600	0.060	--	--	12	12
Berlin	500	0.050	--	--	3	3
Enigma	700	0.070	--	--	11	11
Fargo	1250	0.187	--	22	3	25

(6/1/62)

TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA - Cont'd						
Fitzgerald	11,700	1.750	--	70	71	141
Hahira	1700	0.255	12	--	23	35
Homerville	3500	0.525	12	48	53	113
Irwinville	300	0.030	--	--	6	6
Lakeland	3000	0.450	--	53	43	96
Lenox	1150	0.173	--	--	12	12
Moody AFB	2300	0.750	--	--	--	--
Morven	600	0.060	--	--	7	7
Moultrie	21,000	3.150	--	120	19	139
Nashville	5400	0.810	--	54	77	131
Norman Park	1200	0.180	--	25	19	44
Ocilla	4200	0.630	--	48	56	104
Omega	1350	0.200	--	--	22	22
Pavo	1150	0.173	8	--	21	29
Pitts	525	0.053	--	--	8	8
Poulan	1200	0.180	--	25	27	52
Quitman	6700	1.000	--	65	92	157
Ray City	850	0.085	--	18	8	26
Rochelle	1650	0.250	--	31	24	55
Sparks	1525	0.230	--	27	22	49

(6/1/62)

TABLE W-3 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 1975
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
GEORGIA - Cont'd						
Statenville	650	0.065	--	--	11	11
Sycamore	850	0.085	--	--	18	18
Sylvester	4800	0.720	--	--	65	65
Tifton	18,500	2.780	--	100	279	379
Abraham Baldwin College	500	0.050	--	--	--	--
Twin Lakes	300	0.030	--	--	--	--
Ty Ty	650	0.065	--	22	11	33
Valdosta	41,800	6.280	379	70	645	1094
Willacoochee	1400	0.210	--	--	20	20
Totals	217,271	32.981	541	1,440	2,475	4,456

* Based on January 1, 1960 constant dollars.

(6/1/62)

TABLE W-4

MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
FLORIDA						
Alachua	3000	0.600	2	41	33	76
Branford	2000	0.400	--	48	60	108
Brooker	750	0.113	32	33	45	110
Cedar Key	400	0.060	--	--	--	--
Cherry Lake	800	0.120	--	--	18	18
Chiefland	2400	0.480	14	38	27	79
Cross City	2400	0.480	--	--	24	24
U. S. Radar Station	61	0.032	--	--	--	--
Fort White	750	0.113	--	27	9	36
Greenville	2400	0.480	4	38	36	78
Hampton	1000	0.200	--	35	27	62
High Springs	3000	0.600	50	--	30	80
Jasper	2600	0.530	4	38	15	57
Jennings	1450	0.290	--	41	39	80
Keystone Club S/D	100	0.100	--	--	--	--
Lake Butler	2300	0.460	15	35	33	83
Lake City	14,000	2.800	100	105	120	325
Forest Ranger School	130	0.015	--	--	--	--
Lawtey	1200	0.240	--	35	18	53
Live Oak	10,000	2.000	62	90	120	272

(6/1/62)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000			
			Source and Treatment	Storage	Dist. System	Total
FLORIDA - Cont'd						
Madison	4000	0.800	--	25	24	49
Mayo	1500	0.300	--	27	36	63
Melrose	1200	0.240	--	35	21	56
Newberry	1600	0.320	--	35	9	44
Olustee	1100	0.220	--	35	27	62
Raiford State Prison	5000	1.140	--	--	--	--
Raiford	1350	0.270	--	39	38	77
Shamrock	1650	0.330	16	38	48	102
Starke	7000	1.400	4	52	150	206
Trenton	1600	0.320	--	--	24	24
Waldo	1300	0.260	14	29	24	67
Wellborn	1250	0.250	--	35	33	68
White Springs	1800	0.360	--	35	45	80
Stephen Foster Park	--	0.025	--	--	--	--
GEORGIA						
Adel	7900	1.580	--	90	150	240
Alapaha	1500	0.300	14	38	42	94
Anabi	1000	0.200	32	40	30	102
Ashburn	6300	1.260	--	70	120	190

(6/1/62)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000 Source and Treatment	Storage	Dist. System	Total
GEORGIA - Cont'd						
Barwick	1200	0.240	14	35	36	85
Berlin	950	0.143	--	--	27	27
Chula	800	0.120	28	33	48	109
DuPont	700	0.105	28	31	42	101
Ellenton	900	0.135	28	39	36	103
Enigma	1200	0.240	--	25	30	55
Fargo	2400	0.480	12	44	69	125
Fitzgerald	17,000	3.400	--	132	318	450
Hahira	2500	0.500	--	40	48	88
Homerville	5100	1.020	12	61	96	169
Irwinville	500	0.075	--	18	12	30
Lakeland	4400	0.880	--	58	84	142
Lake Park	800	0.120	28	33	24	85
Lenox	2100	0.420	2	48	57	107
Moody AFB	2300	0.750	--	--	--	--
Morven	1000	0.200	--	35	24	59
Moultrie	31,000	6.200	26	272	600	898
Nashville	8000	1.600	12	82	156	250
Naylor	800	0.120	28	33	18	79
Norman Park	2200	0.440	12	45	60	117
Ocilla	6200	1.240	--	70	120	190

(6/1/62)

TABLE W-4 (CONT'D)
MUNICIPAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* FOR 2000
SUWANNEE BASIN

Municipality	Estimated Population Served	Estimated Water Demand mgd	Estimated Costs in $1,000 Source and Treatment	 Storage	 Dist. System	 Total
GEORGIA - Cont'd						
Omega	2100	0.420	12	43	45	100
Pavo	2000	0.400	12	41	51	104
Pitts	1000	0.200	12	18	29	59
Poulan	2300	0.460	20	48	66	134
Quitman	10,000	2.000	--	105	198	303
Ray City	1600	0.320	--	41	45	86
Rochelle	2400	0.480	--	41	45	86
Sparks	2400	0.480	--	44	53	97
Statenville	1200	0.240	14	38	33	85
Sycamore	1600	0.320	12	35	45	92
Sylvester	7000	1.400	--	60	132	192
Tifton	25,000	5.000	22	200	390	612
Twin Lakes	550	0.083	--	--	15	15
Ty Ty	1200	0.240	--	35	33	68
Valdosta	65,000	13.000	804	626	1440	2870
Willacoochee	2200	0.440	--	48	48	96
Totals	317,391	63.559	1,501	3,784	6,048	11,333

* Based on January 1, 1960 constant dollars.

(6/1/62)

The annual cost of providing water to municipal users by 2000 is estimated to be $4,770,000 assuming that all needs have been met by the year 2000. A breakdown of this annual cost is given below:

Annual equivalent capital cost	$1,668,000
Annual replacement cost	75,000
Annual operation and maintenance cost	3,027,000
Total annual cost (2000)	$4,770,000

BENEFITS

Storage for municipal water supply is frequently one of the purposes served by the development of multi-purpose river basin projects. The cost of developing alternative sources of water supplies most likely to be used in the absence of the project normally provides a measure of the benefits to water supply storage. For most areas of the Basin it may be assumed that water supplies necessary to meet the demands could be obtained from ground water. Where sufficient ground water is not available other alternative sources of surface water have been used in this memorandum.

Because there is no established market value for water as a commodity sold in a competitive market, monetary benefits from water supplies now used or anticipated to be used in the Basin in the future, from public or private sources, are indeterminate. In common practice, the value of water supplies for which no market values are clearly established is estimated from the cost of providing supplies by the least costly, most likely means. Therefore, the benefits are assumed to be equal to the cost of obtaining water by the least costly alternative means. In this memorandum, benefits from water supply storage specifically for municipal use included in any multi-purpose project constructed in the Basin would be at least equal to the cost of developing alternative sources.

DOMESTIC WATER SUPPLIES

INVENTORY

The methods for obtaining basic data on domestic water supply systems have been outlined previously in the PROCEDURES AND INVESTIGATIONS section.

The number of persons in the Basin served by existing municipal water supply systems is 168,796. The remainder of the Basin population, or 118,400 persons, is served by domestic water supply systems. Average per capita water demand is 50 gallons per day which indicates a total existing domestic water demand of 5.9 mgd.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

Based on the analysis of the SERB area wide random-sample survey of domestic supplies, it is estimated that there are 26,300 domestic water supply systems in the Suwannee Basin. Of this total, 9,130 systems are drilled wells, 12,700 are dug wells, 1,370 bored wells, 1,680 driven wells, and 1,420 are springs.

It is estimated that 2,150 systems have an insufficient source of supply and another 5,450 have sources of improper construction. There are 18,800 supplies which have pressure systems and of the remaining 7,500 supplies, 7,200 use hand pumps or buckets. There are 15,960 systems which do not meet accepted health standards and 7,100 systems have water quality problems, the most significant of which are hardness and high iron concentrations.

WATER SUPPLY SYSTEMS REQUIREMENTS FOR 1960

In order to provide a safe, potable supply of water for human consumption, certain improvements will be needed for many of the existing domestic systems. These improvements consist of development of new sources for those systems which have either insufficient yield or sources of improper construction. Systems which presently use hand pumps or buckets should install pressure systems and those systems which do not meet health standards because of improper construction will need seals and covers. Softening or other treatment of those sources which have water quality problems is also needed. In addition, approximately 5,000 persons now served by domestic systems should connect to municipal water supply systems. Costs for providing these needs are listed below.

Total capital outlay to improve existing domestic water supply systems to meet accepted health standards is estimated to be $11,796,800. This includes $4,831,600 for development of new sources, $586,400 for sanitary seals and covers, $3,382,500 for pressure systems, $2,094,000 for treatment facilities, and $902,300 for complete new systems.

FUTURE WATER SYSTEM REQUIREMENTS

In determining future requirements it was assumed that all domestic water supply systems in the future will be pressurized and will meet accepted health standards. By 1975, it is estimated that a total of 26,900 domestic systems serving 121,100 persons will be in existence in the Suwannee Basin. This will require construction of 600 complete, new systems (wells, seals and covers, pressurization) and treatment for about 27 percent of the systems. Total cost of the new systems is estimated to be $771,200 based on 1960 constant dollars. This cost includes $721,700 for wells, seals and covers, and pressure systems and $49,500 for treatment facilities.

By 2000, an estimated 90,300 persons will be served by a total of 20,100 domestic water supply systems. This represents a decrease in population served by domestic systems which will result in the abandonment of 6,800 systems between 1975 and 2000.

Average domestic water demand by 1975 will be 8.5 mgd, based on 70 gpcd and in 2000 it will be 9.0 mgd based on 100 gpcd.

ANNUAL COSTS

For the purposes of this memorandum it is assumed that present and future needs of the farm and rural non-farm domestic water systems will be met on an individual basis.

The annual cost of providing domestic water from existing systems is estimated to be $1,824,000. Based on an estimated existing capital investment of $21,056,300, the breakdown of annual cost is given below:

Annual equivalent capital cost	$1,022,500
Annual replacement cost	484,300
Annual operation and maintenance cost	317,200
Total annual cost (1960)	$1,824,000

The annual cost of providing water for domestic water supply systems in 1975 is estimated to be $2,633,200 based on an estimated total investment of $31,666,500. The breakdown of total annual cost for 1975 is given below:

Annual equivalent capital cost	$1,537,700
Annual replacement cost	728,300
Annual operation and maintenance cost	367,200
Total annual cost (1975)	$2,633,200

The annual cost of providing water from the domestic systems expected to exist in 2000 is estimated to be $1,967,600 based on an estimated total investment of $23,661,600. The breakdown of annual cost for the year 2000 is given below:

Annual equivalent capital cost	$1,149,000
Annual replacement cost	544,200
Annual operation and maintenance cost	274,400
Total annual cost (2000)	$1,967,600

(6/1/62)

INDUSTRIAL WATER SUPPLIES

INVENTORY

Data secured by field surveys of 27 industrially-owned water systems are shown in Table W-5. Only those industries with their own source of water were surveyed, although 11 of the industries shown in Table W-5 supplement their supplies with water from municipal water systems. The 27 industries surveyed use 21.93 mgd from their own sources, and the total amount of water supplied to all industries by municipal systems is 1.8 mgd. Thus, the total industrial water use in the Basin is approximately 23.73 mgd. The mining industry is the largest user of water and pulp and paper the second largest. Two of the 27 industries surveyed were mines, and one was a pulp and paper mill. The mines use water at the rate of 10.1 mgd, and the paper mill uses 8.8 mgd. The three industries together account for 18.9 mgd or 80 percent of the total industrial water demand in the Basin.

PRESENT STATUS OF WATER SUPPLY SYSTEMS

All of the industries surveyed obtain water (not including that from municipal systems) from wells only. No industry reported that the existing source of water was inadequate to meet demands.

One of the industries provides softening and another provides complete treatment for water used for drinking and sanitation; the others provide no treatment. Six industries reported treatment of water used for processing and boiler use. Process and/or boiler water was softened at 4 of the plants, one of the plants used complete treatment, and one provided simple chlorination. Two plants provide treatment for cooling water. One plant used complete treatment for cooling water and one used softening.

No attempt was made to determine consumptive water use by industry, however, it is believed to be relatively small.

FUTURE WATER SUPPLY REQUIREMENTS FOR 1975 AND 2000

Industrial water use from industrially owned sources by 1975 and the year 2000 is estimated to be 30.38 mgd and 53.67 mgd respectively. Table W-6 gives the projected water demands and water system needs (in terms of cost) for 1975 and 2000.

Between 1960 and 1975, industrial water supply system needs for existing and new plants will include installation of 9 wells, 3 chlorinators, one storage facility, one corrosion control device, and additions to one softening plant.

(6/1/62)

TABLE W-5
BASIC DATA ON INDUSTRIAL WATER SUPPLY SYSTEMS
SUWANNEE BASIN

Location by State and County	Code	Type of Industry	Number of Employees	Drinking and Sanitation			Processing and Boiler			Cooling			Total Plant Demand mgd
				Source	Treatment	Average mgd	Source	Treatment	Average mgd	Source	Treatment	Average mgd	
FLORIDA													
Alachua	A	meat pkg	450	well	none	0.007	well	none	0.200	--	--	--	0.207
	B	chemical	14	well	none	undet	--	--	--	well	none	0.058	0.058
Bradford	C	mining	140	wells	none	undet	wells	none	4.320	--	--	--	4.320
Clay	D	mining	200	wells	none	undet	well	none	5.760	--	--	--	5.760
Dixie	E	naval stores	22	city	--	--	well	none	0.350	--	--	--	0.350
	F	naval stores	100	well	none	undet	well	soften	0.576	well	none	recirculate	0.576
GEORGIA													
Ben Hill	E	naval stores	11	city	--	--	city & well	none	*	city & well	none	*	0.144
Berrien	M	meat pkg	6	city	--	--	well	none	*	well	none	*	undet
Clinch	G	naval stores	8	city	--	--	well	soften	*	well	none	*	0.020
	H	metal	125	well	none	*	well	none	*	well	none	*	0.002
Colquitt	I	meat pkg	300	wells	none	*	wells	none	*	wells	none	*	0.700
	J	chemical	75	city	--	--	well	chlor	*	well	none	*	0.360
	K	metal	15	city	--	--	--	--	--	well	none	0.002	0.002
Lowndes	C	pulp & paper	460	wells	soften	0.250	wells	soften	*	wells	soften	*	8.750
	V	bottling	30	well	comp treat	*	well	comp treat	*	well	comp treat	*	0.020
	W	meat pkg	24	well	none	*	well	none	*	well	none	*	0.040
	X	naval stores	260	well	none	*	well	none	*	well	none	*	0.145
	Y	naval stores	8	city	--	--	well	none	*	well	none	*	0.019
	Z	meat pkg	5	well	none	*	well	none	*	well	none	*	0.009
	AA	naval stores	37	city & well	--	--	well	none	*	well	none	*	0.009
	BB	chemical	60	city	--	--	well	none	*	well	none	*	0.013
	CC	ice plant	5	well	none	*	well	none	*	well	none	*	0.120
Tift	P	ice plant	5	well	none	*	well	none	*	well	none	*	0.040
	Q	wood preser	3	undet	--	--	well	soften	*	well	none	*	0.001
	R	naval stores	15	city	--	--	well	none	*	well	none	*	0.130
	S	chemical	20	city	--	--	well	none	*	well	none	*	0.025
Worth	O	meat pkg	16	well	none	*	well	none	*	well	none	*	0.008
total													21.928

* Breakdown of water use not available. See last column for total demand.

(6/1/62)

TABLE W-6
INDUSTRIAL WATER SUPPLY SYSTEMS
ESTIMATED NEEDS AND COSTS* - 1975 AND 2000
SUWANNEE BASIN

Location by State and County	Code	Estimated 1975 Requirements		Estimated 2000 Requirements	
		mgd	Costs	mgd	Costs
FLORIDA					
Alachua	A	0.322	--	0.737	--
	B	0.087	--	0.140	--
Bradford	C	6.170	24,000	10.790	48,000
Clay	D	8.210	24,000	14.390	72,000
Dixie	E	0.460	2,000	0.690	--
	F	0.755	--	1.130	22,000
GEORGIA					
Ben Hill	E	0.192	--	0.280	--
Berrien	M	0.030	--	0.075	--
Brooks	New[1]	0.100	14,000	0.375	--
Clinch	G	0.027	--	0.040	--
	H	0.003	--	0.006	--
Colquitt	I	1.100	2,000	2.495	94,000
	J	0.625	--	1.730	12,000
	K	0.003	--	0.006	--
Lowndes	C	11.420	318,000	19.010	1,004,000
	V	0.027	--	0.040	--
	W	0.060	--	0.140	--
	X	0.190	--	0.290	--
	Y	0.026	--	0.040	--
	Z	0.010	--	0.025	--
	AA	0.013	--	0.020	2,000
	BB	0.220	--	0.575	12,000
Tift	P	0.050	--	0.070	--
	Q	0.001	--	0.002	--
	R	0.170	--	0.260	2,000
	S	0.050	--	0.136	--
	New[1]	0.040	14,000	0.150	--
Worth	O	0.014	--	0.030	--
		30.375	398,000	53.672	1,268,000

[1] Canning

* Based on January 1, 1960 constant dollars.

(6/1/62)

Industrial development will have expanded by 2000 to the point that water supply system needs will include provision of 19 new wells, 2 storage facilities, 3 corrosion control systems, and one softening plant expansion.

FUTURE WATER SUPPLY PROBLEMS

No significant industrial water supply problems, from the standpoint of quantity and quality, are expected in the future. The major portion of water supplied is obtained from industrially owned systems, and this trend is expected to continue into the future.

ANNUAL COSTS

Existing industrial water supply systems are reported to be adequate for 1960 needs. The annual cost of providing industrial water in 1960 from existing supplies is estimated to be $606,500. A breakdown of this cost, based on the cost of existing facilities, is given below:

Annual equivalent capital cost	$ 71,300
Annual replacement cost	8,200
Annual operation and maintenance cost	527,000
Total annual cost (1960)	$606,500

The annual cost of providing the industrial water required by 1975 is estimated to be $835,900. This includes annual equivalent capital costs of existing facilities in 1960, and facilities recommended to meet additional needs between 1960 and 1975. The replacement cost is based on the total investment as of 1975, and the operation and maintenance cost is based on the total installed systems as of 1975. A breakdown of these costs is given below:

Annual equivalent capital cost	$ 90,700
Annual replacement cost	10,200
Annual operation and maintenance cost	735,000
Total annual cost (1975)	$835,900

The annual cost of providing the industrial water needed by 2000 is estimated to be $1,466,000, assuming that all the needs have been met by the year 2000. A breakdown of this cost is given below:

Annual equivalent capital cost	$ 152,000
Annual replacement cost	14,000
Annual operation and maintenance cost	1,300,000
Total annual cost (2000)	$1,466,000

(6/1/62)

BENEFITS

Storage for industrial water supply is frequently one of the purposes served by the development of multi-purpose river basin projects. The cost of developing alternative sources of water supplies most likely to be used in the absence of the project normally provides a measure of the benefits to water supply storage. For most areas of the Basin it may be assumed that water supplies necessary to meet the demands could be obtained from ground water. Where sufficient ground water is not available other alternative sources of surface water have been used in this memorandum.

Because there is no established market value for water as a commodity sold in a competitive market, monetary benefits from water supplies now used or anticipated to be used in the Basin in the future from public or private sources, are indeterminate. In common practice, the value of water supplies for which no market values are clearly established is estimated from the cost of providing supplies by the least costly, most likely means. Therefore, the benefits are assumed to be equal to the cost of obtaining water by the least costly alternative means. In this memorandum, benefits from water supply storage specifically for industrial use included in any multi-purpose project constructed in the Basin would be at least equal to the cost of developing alternative sources.

SUMMARY

1960

The total average water demand of existing (1960) municipal, domestic, and industrial water systems whose source is within the Suwannee Basin is estimated to be 44.65 mgd. There are 69 municipal water systems (serving 168,800 persons) an estimated 26,300 domestic water systems (serving 118,400 persons) and 27 industrially-owned systems. The total annual cost of providing water for municipal, domestic, and industrial uses is estimated to be $3,991,500.

1975

By 1975, the total average water demand of municipal, domestic, and industrial water systems whose source of water is within the Basin is estimated to be 71.86 mgd. The municipal water systems will serve 217,300 persons and there will be an estimated 26,900 domestic water systems serving 121,100 persons. The total annual cost of providing water for municipal, domestic, and industrial uses is estimated to be $6,169,100 by 1975.

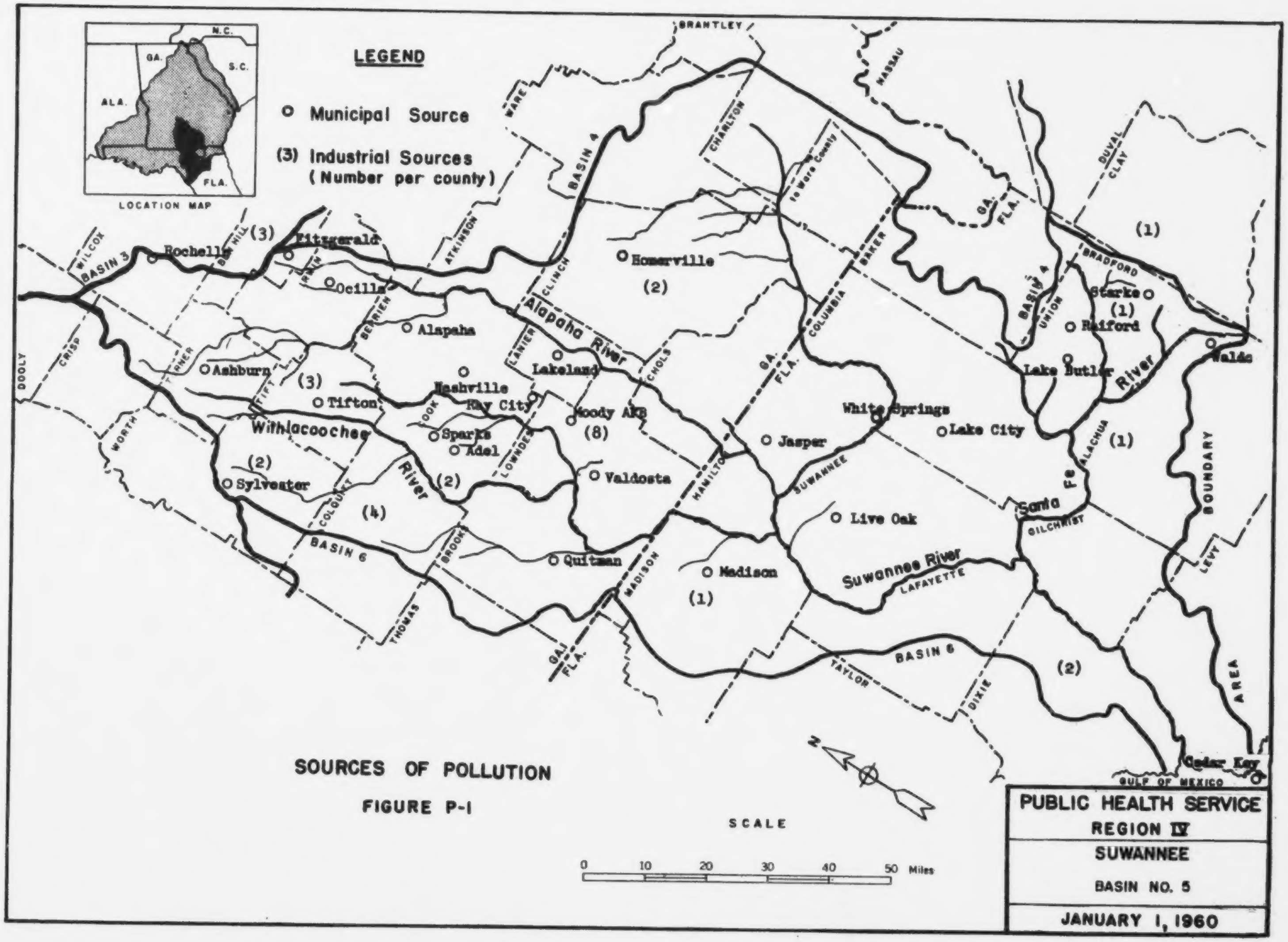
(6/1/62)

2000

By the year 2000, the total average water demand of municipal, domestic, and industrial water systems whose source of water is within the Basin is estimated to be 126.23 mgd. The municipal water systems will serve 317,400 and there will be an estimated 20,100 domestic water systems serving 90,300 persons. The total annual cost of providing water for municipal, domestic and industrial water uses is estimated to be $8,203,600 by the year 2000.

Ground water supply sources in the Suwannee Basin are expected to be adequate to meet demands by the year 2000 if they are properly developed. Softening or iron removal will be required for many municipal and industrial uses.

POLLUTION ABATEMENT


LEGEND
○ Municipal Source
(3) Industrial Sources (Number per county)
LOCATION MAP
N.C.
S.C.
GA.
ALA.
FLA.
Rochelle
Fitzgerald
Ocilla
Alapaha
Ashburn
Tifton
Nashville
Ray City
Lakeland
Moody AFB
Sparks
Adel
Sylvester
Valdosta
Quitman
Homerville
Jasper
White Springs
Lake City
Live Oak
Madison
Lake Butler
Raiford
Starke
Waldo
Cedar Key
Alapaha River
Withlacoochee River
Suwannee River
Santa Fe River
BASIN 3
BASIN 4
BASIN 6
GA.
FLA.
BOUNDARY
AREA
GULF OF MEXICO
WILCOX
BEN HILL
IRWIN
DOOLY
CRISP
TURNER
WORTH
TIFT
COOK
BERRIEN
ATKINSON
WARE
CLINCH
LANIER
LOWNDES
COLQUITT
BROOKS
THOMAS
ECHOLS
CHARLTON
BRANTLEY
NASSAU
to Ware County
BAKER
COLUMBIA
HAMILTON
MADISON
SUWANNEE
LAFAYETTE
TAYLOR
DIXIE
GILCHRIST
ALACHUA
UNION
BRADFORD
DUVAL
CLAY
LEVY
(1)
(2)
(3)
(4)
(8)
N
SCALE
0 10 20 30 40 50 Miles
PUBLIC HEALTH SERVICE
REGION IV
SUWANNEE
BASIN NO. 5
JANUARY 1, 1960

SOURCES OF POLLUTION

FIGURE P-1

INTRODUCTION

SCOPE OF MEMORANDUM

This memorandum contains data and information concerning the present status of municipal and industrial sewage works which discharge to the Suwannee Basin.

Projected future pollution abatement requirements for industries and municipalities by the years 1975 and 2000 are presented, as are suggested solutions to present and anticipated future inadequacies. In connection with these solutions, an appraisal of the benefits to be derived from the proposed program and the annual costs of pollution abatement are included.

PROCEDURES AND INVESTIGATIONS

Existing data on pollution abatement in the Basin were obtained from reports, records, and correspondence of the Florida State Board of Health, the Georgia Department of Public Health, the Georgia State Chamber of Commerce, the Georgia Department of Commerce, the U. S. Department of Agriculture and other Federal and State agencies. Where data were found to be lacking or outdated, extensive field investigations were conducted. Field investigations were conducted by the Georgia Department of Public Health, and the Florida State Board of Health, and data were submitted to the Public Health Service for inclusion in this memorandum. These field investigations included visits to municipalities, small communities, industries, and institutions.

Data were obtained regarding 27 municipal (which includes 5 institutions) and 30 industrially owned sewage and waste works in the Basin, (Figure P-1). Industries connected to municipal sewer systems were not inventoried. The data were carefully studied to establish both the present and future pollution abatement requirements.

BASIC ASSUMPTIONS

Populations of individual municipalities have been projected to 1975 and 2000 using census data where available or estimated populations for communities not listed in the census reports.

Projections were made by applying the geometric progression method based on the rate of increase over the period 1930-1960, modified by considerations of changing economic conditions. However, the population projections of urban areas (municipalities of 2500 or more) were adjusted to match projections made by the U. S. Study Commission.

Existing industries are expected to increase or decrease their waste discharges in the future in proportion to the projected industrial growth or decline. In addition, four new food processing industries are expected to locate in the Basin. For the purpose of this memorandum, it is assumed that municipalities of less than 800 should be sewered now and municipalities of less than 800 should be sewered whenever the present methods of disposal are considered inadequate. It is also assumed that each municipality, regardless of population, now partially sewered should extend its collection system to serve the total population.

In the administration of "Grants for Construction" under Section 6 of Public Law 660 and its amendments, the Public Health Service has established "The substantial removal of settleable solids" as the minimum acceptable treatment for projects in which the Federal Government participates. In general, the Public Health Service considers primary treatment to be the minimum acceptable degree of treatment for municipal sewage and an equivalent treatment the minimum for industrial liquid wastes. The need for additional treatment has been determined on the basis of expected dilution water available during periods of low stream flow and/or downstream water use. With the exception of the Florida portion of the Basin, stabilization ponds have been recommended for most municipalities with less than 1500 persons.

It is assumed that primary treatment plants will effect 35 percent BOD removal and secondary plants will effect 85 percent BOD removal. Tertiary treatment or a greater than 85 percent BOD removal has not been considered for purposes of reducing low flow requirements. At these higher treatment efficiencies, dilution water requirements for water quality control depend on dilution of nutrients and chemicals present in the water rather than dilution of remaining BOD. Plant nutrients and chemicals are reduced very little, if any, in conventional sewage treatment plants and must, therefore, be considered as important pollutants in sewage effluents.

Sewage works costs have been estimated on the basis of per capita cost data developed by the Public Health Service and adjusted on the basis of the January 1, 1960 Engineering News-Record Construction Cost Index for Atlanta, Georgia. Engineering, legal, and financing costs have been added on the basis of United States experience for the period July 1956-June 1959. Sewage system costs include the cost of structures, devices, equipment, and appurtenances intended for the collection and pumping of sewage. Treatment plant costs include the cost of treatment facilities and outfall lines.

Annual equivalent capital costs, annual operation and maintenance costs, and replacement costs of existing and needed pollution abatement facilities were estimated on the basis of January 1, 1960 constant dollars. An interest rate of 4¼ percent was used for determining annual costs for both industries and municipalities.

GENERAL

Water pollution may be defined as the adding to water of any substance, or the changing of water's characteristics in any way

way which interferes with its use for legitimate purposes. Water polluting substances may be classified according to eight general categories: (1) Sewage and other oxygen demanding wastes, (2) infectious agents, (3) plant nutrients, (4) organic chemical exotics, (5) sediments, (6) radioactive substances, (7) heat, and (8) toxic and other mineral and chemical substances.

The Nation and its communities, as well as business and private operations and individuals, incur losses or damages because of water pollution. Some of these losses or damages are reflected directly in additional costs for construction, operation and maintenance of water treatment facilities. By far the larger share of the total damages is not directly accountable. The impairment to health, the loss or dimunition of fishing and recreational uses, and depreciated property values, caused by polluted waters, have an adverse economic impact which is diffused throughout society. This is paid for through the reduction in utility of the water resources and the restriction on economic growth rather than through dollar payments for corrective devices. Unfortunately, these indirect consequences of pollution are not readily expressed in dollar terms because of their diffusiveness and because they are not recorded by direct, open-market transactions. Nevertheless, such adverse consequences are real and constitute a handicap to the fulfillment of economic and social goals.

Pollution control measures alleviate these adverse conditions and produce economic benefits associated with the improved waters. These benefits are often not apparent to the public, however, because they constitute insurance for future usefulness as well as for immediate purposes, or they may be indirect or intangible. The computation of these benefits faces the same difficulties as the computation of the total damages. That is, the dollar measurement problem has not yet been solved and a yardstick for actions or events not recorded in market transactions is lacking. Many of the benefits from pollution control are in this nonmarket realm, e.g., enhancement of fishing and recreational opportunity, protection of health, scenic improvement, and assurance of the future utility of water resources for various other purposes. The private market price system, therefore, cannot be relied upon solely or chiefly to provide the measurement. New devices for taking into account the social or public values must be devised.

INVENTORY OF POLLUTION ABATEMENT

SOURCES OF POLLUTION

The surface waters of the Basin are used for the final disposal of liquid wastes, treated and untreated, from 27 municipalities (including 5 institutions), and 30 industries as shown in Tables P-1 and P-2. Municipalities and institutions discharge 9.0 mgd of sewage of which 8.4 mgd has undergone treatment of some type, and industries discharge 20.7 mgd of which 19.2 mgd has undergone treatment of some type.

A total of 103,600 persons are served by the 27 municipalities and institutions which discharge to the Suwannee Basin. The total population equivalent (PE) of the municipal sewage in the Suwannee Basin is estimated to be 138,400 before treatment and 74,700 of this total is discharged to the Basin's waters after treatment.

The industrial wastes produced in the Basin include textile, metal, food, naval stores, mining, chemical, and pulp and paper wastes. Distribution of the number of plants engaged in these activities is fairly uniform. The strength of the organic wastes from the 7 industries for which data was available is estimated to be 227,400 PE based on BOD. The PE of 10 industries inventoried was undetermined. There are 10 other industries which produce inorganic liquid wastes such as acids, alkalies, sediments, etc. The population equivalent of the industrial wastes after treatment is estimated to be 33,100.

The waters of the Basin also receive pollution from natural sources and from the agricultural use of the land. Pollution from natural sources include organic material leached from the decaying matter in the forests and swamps and minerals dissolved from the soil and rocks. The pollution resulting from the agricultural use of the land includes organic and mineral fertilizers, insecticides, pesticides, and herbicides which are washed into the waters during heavy rains or which are inadvertently deposited into the waters during application. Drainage from livestock feed lots, dairy barns, pig pens, manure heaps, and other farm refuse also adds to the pollution load carried by the streams.

EXISTING SEWAGE TREATMENT FACILITIES

As shown in Table P-1, 9 municipalities and institutions provide secondary treatment for sewage collected from 40,010 persons (or 39 percent of the total sewered population discharging sewage to the Basin's waters). Stabilization ponds have been considered as secondary treatment plants for the purpose of this summary.

There are 9 municipalities and institutions in the Basin which provide primary treatment for the sewage collected from 53,400 persons (or 52 percent of the total sewered population discharging sewage to the Basin's waters).

Septic tanks are provided by 6 municipalities and institutions serving 2,700 persons (or about 3 percent of the total sewered population discharging sewage to the Basin's waters).

The remaining 3 municipalities and institutions which discharge sewage to the Basin's waters provide no treatment. Approximately 7,500 persons (or 7 percent of the total sewered population discharging sewage to the Basin's waters) are served by the collection systems in these municipalities.

TABLE P-1
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SUWANNEE BASIN

Municipality	1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity		Estimated PE (BOD)		Receiving Stream
					PE 1,000s	Flow mgd	Untr'd Waste	Disch'd Waste	
FLORIDA									
Cedar Key	668	400	0.040	septic tk	0.50	0.050	400	350	Waccasassa Bay
Jasper	2,103	2,150	0.250	primary	3.00	0.300	2,150	430	swamp-Alapaha River
Lake Butler	1,311	850	0.085	septic tk	0.56	0.056	850	680	Butler Cr-New River
Lake City	9,465	9,760	1.200	secondary	15.00	1.500	12,000	975	Alligator Lake
Live Oak	6,544	850	0.085	secondary	7.50	0.750	850	125	lagoon with no outlet
Madison	3,239	1,900	0.160	secondary	3.50	0.350	1,900	190	swamp-Suwannee R
Raiford Prison	--	3,500	0.320	secondary	5.00	1.650	3,500	320	New R-Santa Fe R
Starke	4,806	4,500	0.450	primary	4.40	0.440	4,500	3,600	Alligator Cr-Santa Fe R
Waldo	735	350	0.035	septic tk	0.79	0.079	350	320	cr-Santa Fe R
White Springs	633	350	0.035	septic tk	0.70	0.070	350	315	Suwannee R
GEORGIA									
Adel	4,321	3,250	0.320	none	--	--	3,200	3,200	Bear Cr-Withlacoochee R
Alapaha Housing Authority	--	85	0.009	septic tk	undet	undet	85	75	Alapaha R
Ashburn #1	3,291	1,900	0.190	primary	1.40	0.168	1,900	1,580	Hat Cr-Alapaha R
#2		500	0.050	primary	0.42	0.060	500	420	Ashburn Br-Little R
Fitzgerald	8,781	8,750	0.060	stab ponds	9.00	0.900	10,400	1,000	Turkey Br-Willachoochee R
Homerville	2,634	2,500	0.175	primary	undet	undet	2,500	2,100	Saviors Cr-Okefenokee Swamp
Lakeland	2,236	1,000	0.080	none	--	--	1,000	1,000	Big Cr-Alapaha R
Moody AFB	--	2,700	0.400	secondary	2.70	0.750	2,700	150	Cat Cr-Withlacoochee R
Nashville	4,070	3,200	0.225	none	--	--	3,200	3,200	Reedy Cr-Withlacoochee R
Ocilla	3,217	2,700	0.225	primary	undet	undet	2,700	1,750	Stump Cr-Willacoochee R
Quitman	5,071	3,850	0.375	primary	8.00	0.800	23,000	19,000	Okapilco Cr-Withlacoochee R
Ray City Housing Authority	--	50	0.005	stab pond	0.10	0.010	50	10	br-Cat Cr-Withlacoochee R
Rochelle	1,235	1,200	0.120	primary	1.00	0.110	1,200	800	Mill Cr-Alapaha R
Sparks	1,158	700	0.015	septic tk	0.70	0.070	700	600	br-Bear Cr-Withlacoochee R

(6/1/62)

TABLE P-1 (CONT'D)
BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION
SUWANNEE BASIN

Municipality	1960 Population	Estimated Population Served	Estimated Average Flow mgd	Type of Treatment	Design Capacity		Estimated PE (BOD)		Receiving Stream
					PE 1,000s	Flow mgd	Untr'd Waste	Disch'd Waste	
GEORGIA - Cont'd									
Spence AFB	--	500	0.100	secondary	under	1.500	950	95	Indian Cr-Little R
Sylvester	3,610	3,500	0.250	primary	5.00	0.500	3,500	2,300	Warrior Cr-Little R
Tifton #1	9,903	5,000	0.500	secondary	7.50	0.810	7,000	2,100	New R
#2		7,000	0.750	secondary	10.00	0.100	10,000	3,000	br-Little R
Valdosta[1]	30,652	30,600	2.500	primary	37.00	5.000	37,000	25,000	Sugar Cr-Withlacoochee R
Totals		103,595	9.009				138,435	74,685	

[1] Serves 1,000 in Remerton.

TABLE P-2

BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION

(Excludes industries connected to municipal sewer systems)

SUWANNEE BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
FLORIDA									
Alachua	A	450	food	meat pk	0.200	none	20,000	20,000	undet
Bradford	C	140	mining	organic	4.320	chem prec & neut	undet	undet	Boggy Cr-Black Cr
Clay	D	200	mining	organic	5.760	chem prec & neut	undet	undet	Alligator Cr
Dixie	E	22	chemical	organic	0.240	none	undet	undet	br-Suwannee R
	F	100	naval stores	oils & solvents	0.288	none	undet	undet	br-Suwannee R
Madison	G	140	metal	metal plating	0.001	none	--	--	pond
GEORGIA									
Ben Hill	D	375	textile	process	0.025	none	undet	undet	swamp to Willacoochee R
	E	11	naval stores	oils & solvents	0.010	none	undet	undet	Turkey Cr-Willacoochee R
	F	35	food	meat pk	0.040	grease trap	2,000	1,800	Willacoochee R
Clinch	G	8	naval stores	oils & solvents	0.020	none	undet	undet	ditch to Suwanoochee R
	H	125	metal	cooling water	0.002	none	--	--	ditch to Suwanoochee R
Colquitt	I	300	food	meat pk	0.700	stab lagoons	31,400	1,540	Okapilco Cr
	J	75	chemical	acid	0.350	none	--	--	br-Okapilco Cr
	K	15	metal	cooling water	0.002	none	--	--	br-Okapilco Cr
	L	205	metal	chromate, acid & cyanide	0.350	pH adjust lagoons	--	--	Indian Cr-Little R
Cook	A	120	metal	metal plating	0.100	none	--	--	Bear Cr-Withlacoochee R
	B	230	metal	oil, soap, & grease	0.020	none	--	--	ditch-Bear Cr-Withlacoochee R

(6/1/62)

TABLE P-2 (CONT'D)
BASIC DATA ON SOURCES OF INDUSTRIAL POLLUTION
(Excludes industries connected to municipal sewer systems)
SUWANNEE BASIN

Location by State and County	Code	Number of Employees	Type of Industry	Type of Waste	Estimated Average Flow mgd	Treatment Provided	Estimated PE (BOD) Untr'd Waste	Estimated PE (BOD) Disch'd Waste	Discharged To
GEORGIA - Cont'd									
Lowndes	C	460	pulp & paper	Kraft proc	8.000	Bio-oxidation lagoons	169,600	5,600	Withlacoochee R
	U	450	textile	starch	0.046	none	undet	undet	br-Withlacoochee R
	W	24	food	meat pk	0.038	trap	1,800	1,700	canal to Mud Cr-Apalaha R
	X	260	naval stores	oils & solvents	0.135	none	undet	undet	canal to Mud Cr-Alapaha R
	Y	8	naval stores	oils & solvents	0.010	lagoon	undet	undet	no outfall
	Z	5	food	meat pk	0.006	solids removal	1,080	980	canal to Mud Cr-Apalaha R
	AA	37	chemical	organic	0.010	none	undet	undet	undet
	BB	60	chemical	acids	0.013	none	--	--	ditch to Withlacoochee R
Tift	Q	3	wood preser	creosote	0.001	none	--	--	swamp-Little R
	R	15	naval stores	oils & solvents	0.020	none	undet	undet	Little R
	S	20	chemical	acid	0.022	none	--	--	ditch to New R
Worth	N	180	textile	organic	0.001	none	undet	undet	Warrior Cr-Little R
	O	16	food	meat pk	0.008	none	1,500	1,500	Warrior Cr-Little R
Totals					20.738		227,380	33,120	

(6/1/62)

The sewage treatment plant listed for the City of Valdosta, Georgia also serves Remerton, Georgia.

As shown in Table P-2, 9 of the 30 industries listed provide treatment of some degree to their liquid wastes. The remaining 21 industries provide no treatment for their liquid wastes.

Two industries provide the equivalent of secondary treatment and two provide chemical precipitation treatment for their industrial liquid wastes. One industry adjusts pH, one lagoons and one provides solids removal. The remaining 23 industries provide either traps or no treatment at all for their wastes.

All other industries in the Basin discharge liquid wastes either to septic tanks with subsurface drain fields or to municipal sewer systems. Industries disposing of liquid wastes by these methods were not inventoried and no data are available.

Soil conservation practices used in many areas of the Basin are very useful in preventing pollution resulting from agricultural use of the land. Good erosion preventative measures, practiced by the highway and railroad maintenance departments assist in the control of sediment coming from roadway embankments. There are no pollution control measures used especially for the purpose of abating pollution from natural sources.

EFFECTS ON STREAMS

Very limited data are available on the effects of municipal and industrial waste discharges on the quality of the surface waters of the Suwannee Basin. The data that are available are limited mostly to the chemical quality of the surface waters. Much of these data have been summarized and are presented in the report Water Quality Basic Data - Southeast River Basins, 1961, prepared for the U. S. Study Commission by the Public Health Service.

Chemical quality data were available at 4 surface stream stations in the Basin. Two of the stations were on the Alapaha River, one on the Suwannee River, and one on the Santa Fe River. Based on the data that were available, the waters of the Alapaha River are soft whereas the waters of the Suwannee and Santa Fe Rivers were relatively hard. The hardness of the Alapaha River was reported at 7 and 8 ppm and the total dissolved solids at 35 and 45 ppm. In contrast, the average hardness reported at the station on the Suwannee River ranged from 121 to 175 ppm and the average total dissolved solids from 150 to 194 ppm. The hardness reported at the station on the Santa Fe River was 131 ppm and the total dissolved solids was 190 ppm. The reasons for the large differences in the chemical quality of these surface waters is not known.

(6/1/62)

During November 1960, January and February 1961 and June 1961, the Public Health Service conducted field studies at four stations in the Suwannee Basin; two on the Alapaha River near Willacoochee, Georgia and at Statenville, Georgia, one on the Little River near Adel, Georgia, and one on the Withlacoochee River near Pinetta, Florida.

The average dissolved oxygen reported at the two stations on the Alapaha River generally exceeded 75 percent of saturation and the median coliform concentrations were low, ranging from 410 to 1800 Most Probable Number (MPN) per 100 ml. The average organic nitrogen at both stations was relatively high, ranging from 0.51 to 0.59 ppm.

The average dissolved oxygen reported at the station on the Little River was slightly depressed, ranging from 65 to 77 percent of saturation and the median coliform concentrations were low, ranging from 1215 to 2615 MPN per 100 ml. The average organic nitrogen ranged from 0.47 to 0.68 ppm.

The average dissolved oxygen reported at the station on the Withlacoochee River was significantly depressed, ranging from 53 to 55 percent of saturation and the median coliform concentrations were low, ranging from 410 to 4300 MPN per 100 ml. The average organic nitrogen was high (0.48 to 0.63 ppm) as were total phospates (0.23 to 0.57 ppm). From these analysis it appears that the Withlacoochee River at the Florida-Georgia State line is degraded probably due to upstream waste discharges and low stream flow.

As in typical of many surface streams in the lower Coastal Plain Province, the alkalinity and pH of the waters were low and the color was high. The only exception was noted in the Withlacoochee River where the average alkalinity ranged from 23.5 to 95.3 ppm.

Observations of several of the surface streams of the Basin were made by the Georgia Department of Public Health during the inventory phase of this study. The observations made are quoted below:

1. "11/1/60. Alapaha River Highway Bridge, Georgia State Route #32, 3 miles west of Irwinville. There is no flow; no apparent channel; water merely standing in swamp. No visual signs of pollution.

2. 11/2/60. Alapaha River Highway Bridge, U. S. #129, 4 miles north of Alapaha. Typical dry weather flow with the stream width varying from 5 feet to 30 feet, pooling in swamp, with a slight flow from pool to pool. Some scum visible, probably from natural conditions. Water had a typical swamp color.

3. 11/3/60. Alapaha River Highway Bridge, U. S. #129, 1 mile east of Lakeland. Slight flow, less than 1 mile

per second from pool to pool. Width varies from about 10 feet to 40 feet or more at the pools. No signs of pollution; water had typical swamp color.

4. 12/13/60. Alapaha River Highway, Georgia State Route 94, approximately 1 mile west of Statenville. River has a wide flood plain with typical swamp growth. Stream approximately 85 feet wide with a good flow, although the river was at low stage. The water had typical dark swamp coloring. The stream bed and banks were white sand. There were no signs of pollution in the stream.

5. 11/18/60. Little River Highway Bridge, U. S. #82, 2 miles west of Tifton. No apparent channel; little or no flow. No visual signs of pollution.

6. 11/9/60. Little River, Georgia Highway #37, approximately 10 miles west of Adel. Stream had slight flow between pools with very slow flowing channel; approximately 40 feet wide at the bridge. There is a U. S. gaging station downstream from bridge at an abandoned bridge site. Water had typical swamp color. There were no visual signs of pollution although there is a large sand dredging operation on the east bank of the stream just upstream from the road.

7. 11/10/60. Little River at Georgia State Route #122 Bridge, 5 miles west of Hahira. River width varies from 10 to 30 feet with pooling and a low dry weather flow. It has typical swamp colored water with no visual signs of pollution.

8. 12/13/60. Suwannee River Bridge on U. S. 441 just south of Fargo. The river is approximately 150 feet wide at this point and at the time of observation there was a good flow. The water had a very dark swamp color in sharp contrast with the white sand bottom. The stream was at low stage but was flowing with an estimated velocity of 1 foot per second. There were no visual signs of pollution. Although the day was extremely cold, there were people observed with fishing gear on roads leading up stream from this point. Fishing is reported excellent in this area.

9. 12/13/60. Suwannochee Creek Highway Bridge on Georgia State Route #94, east of Fargo. Stream has two channels, one was dry, the other had a very slow flow,

with a width of approximately 35 feet. The water had a dark swamp color. The stream had white, sandy bottom with no visual signs of pollution.

10. 11/4/60. Withlacoochee River Bridge on Georgia State Route #76, 1½ miles west of Nashville. River about 8 feet wide at the bridge with little or no flow; water had a typical swamp color. There were no visual signs of pollution.

11. 11/10/60. Withlacoochee River Highway Bridge, Georgia State Route #122, 5 miles east of Hahira. Stream approximately 30 feet wide with a flow of less than 1 foot per second. Very clean looking water with no signs of pollution.

12. 11/10/60. Withlacoochee River Highway Bridge, Georgia State #94, 2 miles west of Valdosta. River approximately 40 feet wide with a very slow flow of about ½ foot per second; some odor, probably due to effluent from Valdosta sewage treatment plant which is discharged approximately 2 miles upstream from point of observation.

13. 11/8/60. Withlacoochee River Bridge on U. S. Highway #84, approximately 6 miles east of Quitman. Dry weather flow with velocity of less than 1 foot per second with river approximately 75 feet wide. Water had typical swamp color with no visual signs of pollution.

14. 12/12/60. Withlacoochee River Highway Bridge, Georgia State Route 21 at Florida line. River approximately 150 feet wide. Water had dark swamp color. There were no visual signs of pollution. There was good flow in the stream at the time observations were made. The stream at this point has a vertical rock bank on the south side of the river. Excellent fishing is reported in this area.

15. 11/23/60. Willacoochee River Bridge, State Route #32, 6 miles east of Ocilla. Wide swampy flood plain, water in pools dark swamp color. No apparent flow; channel approximately 30 feet wide at bridge, flood plain .4 mile wide. no visual signs of pollution. This is approximately 15 miles (River) below Fitzgerald."

POLLUTION ABATEMENT REQUIREMENTS FOR 1960

SEWERAGE

At the present time, 20 municipalities in the Basin serve only a part of their populations and 14 municipalities with populations of 800 or more have no sewage collection system. The 20 municipalities with existing systems should extend their collection systems to serve an additional 17,580 persons and the 14 municipalities should construct new collection systems to serve 17,600 persons. The total capital outlay required as shown in Table P-3 is estimated to be $1,767,000.

TREATMENT FACILITIES

The degree of treatment required at each municipality has been determined on the basis of dilution water available during periods of low stream flow and/or downstream water use. Dilution water use requirements are discussed more fully in the LOW FLOW AUGMENTATION section of this memorandum.

Existing treatment facilities at 7 municipalities and institutions are adequate for present needs. These are Lake City, Live Oak, Madison, and Raiford Prison, Florida and Fitzgerald, Moody Air Force Base, and Tifton, Georgia.

There are 23 municipalities which presently do not provide treatment or have only septic tanks and should construct new treatment plants. Of this total, 7 should construct secondary treatment plants, 9 should construct stabilization ponds, and 7 should construct primary treatment plants.

There are 10 municipalities which should either make addition or enlargements to their existing treatment plants. Of these, 8 should add secondary units to existing primary treatment plants. The total capital outlay required for needed new construction and additions to existing sewage treatment plants is estimated to be $6,793,000 as shown in Table P-3.

Industrial liquid waste disposal by 5 of the industries surveyed is adequate at present. However, the remaining 25 industries should provide more satisfactory methods of waste treatment and disposal. Three of these industries could connect to nearby municipal sewer systems. Primary treatment should be provided by one of the industries and 6 should provide stabilization ponds. Two industries should provide holding lagoons and the remaining 13 industries should provide either chemical precipitation, pH adjustment, ion exchange or oil removal. The total capital outlay required for industrial pollution abatement facilities in 1960 is estimated to be $503,000 as shown in Table P-4.

OTHER NEEDS

A need exists in the Suwannee Basin and other areas of the Southeast River Basins to determine the effects of pollution from insecticides, pesticides, and herbicides and methods for their controlled application.

(6/1/62)

As stated in the section EFFECTS ON STREAMS, there are very little data available on surface water quality in the Basin. There is a need to collect more information on water quality especially as it is affected by waste discharges and river developments. There is a particular need to study waste treatment and disposal in the larger urban areas of the Basin such as Valdosta, Georgia and also in the Clyattville, Georgia industrial area.

The intermittent nature of many of the receiving streams, the interflow between surface and ground water, which is prevalent in the lower Coastal Plain Province, coupled with the growth and attendant increases in water use and waste discharges will greatly affect water quality within the Basin. The determination of these and other factors affecting water quality will require additional study.

FUTURE POLLUTION ABATEMENT REQUIREMENTS

PROJECTIONS

There are 48 municipalities and institutions expected to have sewage works by 1975. As shown in Table P-5, the total PE of the sewage will be 221,725 before treatment and the PE after recommended treatment is estimated to be 38,080.

By the year 2000, 65 municipalities and institutions are expected to have sewage works. As shown in Table P-5, the total PE of the sewage before treatment will be 330,600 and the estimated PE after recommended treatment will be 53,860.

As shown in Table P-6, industrial wastes discharged by 31 industries will have a total PE before treatment of 334,200 and 666,300 by 1975 and 2000, respectively. These wastes will have an estimated total PE after recommended treatment of 53,670 and 106,840 by 1975 and 2000, respectively. These figures do not include 20 industries for which waste discharges are either undetermined or of an inorganic nature. It is assumed that all other industries in the Basin will discharge wastes to subsurface systems, evaporation ponds or to municipal sewerage systems.

SEWERAGE

Assuming that sewerage requirements for 1960 will have been met, additional sewerage construction will be required in 45 municipalities by 1975. These 45 municipalities will require extension of the sewage collection systems required for 1960 to serve an additional 42,200 persons. As shown in Table P-7, the total capital outlay required for extension of sewerage systems is estimated to be $2,111,000 to meet 1975 needs.

TABLE P-3
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SUWANNEE BASIN

	Treatment Facilities		Estimated Costs in $1,000		
Municipality	Des'd for (1,000 PE)	Type Recommended	Sewerage	Treatment	Total
FLORIDA					
Alachua	2.5	secondary	99	316	415
Cedar Key	0.7	primary	13	81	94
Chiefland	2.0	secondary	73	268	341
Cross City	2.0	secondary	93	268	361
Greenville	1.8	secondary	66	250	316
High Springs	2.5	primary	116	193	309
Jasper	3.0	secondary	--	145	145
Lake Butler	1.8	secondary	23	250	273
Live Oak	7.5	secondary	285	--	285
Madison	3.5	secondary	67	--	67
Newberry	1.6	secondary	55	229	284
Starke	4.5	secondary	15	204	219
Trenton	1.2	secondary	47	185	232
Waldo	0.9	secondary	19	154	173
White Springs	1.0	primary	14	103	117
GEORGIA					
Adel	5.4	secondary	54	564	618
Alapaha Housing Authority	0.8	secondary	27	20	47
Ashburn	3.3	secondary	45	316	361
Fargo	1.3	secondary	48	28	76
Hahira	1.7	secondary	65	33	98
Homerville	2.7	secondary	7	135	142
Lakeland	3.0	primary	62	222	284
Lenox	1.2	secondary	40	27	67
Nashville	4.0	secondary	44	458	502
Norman Park	1.2	secondary	45	27	72
Ocilla	3.2	secondary	29	160	189
Omega	1.4	secondary	47	30	77
Pavo	1.2	secondary	41	27	68
Quitman	26.2	primary	61	723	784
Ray City	0.9	secondary	33	20	53
Rochelle	1.3	secondary	2	75	77
Sparks	1.5	secondary	23	31	54
Sylvester	5.0	secondary	6	221	227
Valdosta	38.0	secondary	50	1,000	1,050
Willacoochee	1.4	secondary	53	30	83
Totals			1,767	6,793	8,560

(6/1/62 *Based on January 1, 1960 constant dollars.

TABLE P-4
INDUSTRIAL POLLUTION ABATEMENT
ESTIMATED NEEDS AND COSTS* FOR 1960
SUWANNEE BASIN

Location by State and County	Code	Type of Waste	Treatment Recommended	Est. Cost of Treatment $1,000
FLORIDA				
Alachua	A	meat pkg	stab pond	80
Dixie	E	organic	chem precip	41
	F	oils & solvents	chem precip	45
Madison	G	metal plating	chem precip	10
GEORGIA				
Ben Hill	D	textile process	stab pond	10
	E	oils & solvents	chem precip	10
	F	meat pkg	stab pond	19
Clinch	G	oils & solvents	chem precip	15
	H	cooling water	holding lagoon	5
Colquitt	J	acids	pH adjust	50
	K	cooling water	holding lagoon	5
Cook	A	metal plating	ion exchange	42
	B	oils, soap & grease	city sewers	--
Lowndes	U	starch	city sewers	--
	W	meat pkg	stab pond	18
	X	oils & solvents	chem precip	31
	Y	oils & solvents	city sewers	--
	Z	meat pkg	primary	56
	AA	oils & solvents	chem precip	10
	BB	acids	pH adjust	5
Tift	Q	creosote	oil removal	5
	R	oils & solvents	chem precip	15
	S	acids	pH adjust	5
Worth	N	textile process	stab pond	10
	O	meat pkg	stab pond	16
Total				503

* Based on January 1, 1960 constant dollars.

(6/1/62)

TABLE P-5
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SUWANNEE BASIN

Municipality	1975			2000		
	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
FLORIDA						
Alachua	secondary	2,450	370	secondary	3,000	450
Branford	primary	1,000	650	primary	2,000	1,300
Cedar Key	primary	500	335	primary	400	260
Cherry Lake	--	--	--	secondary	800	120
Chiefland	secondary	1,950	295	secondary	2,400	360
Cross City	secondary	2,000	300	secondary	2,400	360
Greenville	secondary	1,800	270	secondary	2,400	360
Hampton	--	--	--	secondary	1.000	150
High Springs	primary	2,500	1,600	primary	3,000	1,950
Jasper	secondary	2,700	405	secondary	2,850	430
Jennings	primary	800	520	primary	1,450	940
Lake Butler	secondary	1,750	260	secondary	2,300	345
Lake City	secondary	15,000	2,250	secondary	17,500	2,620
Lawtey	secondary	900	135	secondary	1.200	180
Live Oak	secondary	8,000	1,200	secondary	12.500	1.870
Madison	secondary	3,500	525	secondary	4,000	600
Mayo	primary	900	585	primary	1.500	970
Melrose	secondary	850	125	secondary	1.200	180
Newberry	secondary	1,450	220	secondary	1.600	240

(6/1/62)

TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SUWANNEE BASIN

Municipality	1975 Treatment Recommended	 PE Untreated Waste	 PE Discharged Waste	2000 Treatment Recommended	 PE Untreated Waste	 PE Discharged Waste
FLORIDA - cont'd						
Olustee	--	--	--	secondary	1,100	165
Raiford	--	--	--	secondary	1,350	205
Raiford St. Prison	secondary	5,000	750	secondary	5,000	750
Shamrock	secondary	850	125	secondary	1,650	250
Starke	secondary	5,500	825	secondary	7,000	1,050
Trenton	secondary	1,200	180	secondary	1,600	240
Waldo	secondary	900	135	secondary	1,300	195
Wellborn	--	--	--	secondary	1,250	190
White Springs	primary	1,050	630	secondary	1,800	270
GEORGIA						
Adel	secondary	5,400	810	secondary	7,900	1,180
Alapaha	secondary	800	120	secondary	1,500	225
Arabi	--	--	--	secondary	1,000	150
Ashburn	secondary	4,300	645	secondary	6,300	960
Barwick	--	--	--	secondary	1,200	180
Berlin	--	--	--	secondary	950	140
Chula	--	--	--	secondary	800	120

(6/1/62)

TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SUWANNEE BASIN

	1975			2000		
Municipality	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
GEORGIA - cont'd						
Ellenton	--	--	--	secondary	900	135
Enigma	--	--	--	secondary	1,200	180
Fargo	secondary	1,250	190	secondary	2,400	360
Fitzgerald	secondary	14,600	2,200	secondary	21,200	3,180
Hahira	secondary	1,700	255	secondary	2,500	375
Homerville	secondary	3,500	525	secondary	5,100	765
Lakeland	primary	3,000	1,950	secondary	4,400	660
Lake Park	--	--	--	secondary	800	120
Lenox	secondary	1,150	170	secondary	2,100	315
Moody AFB	secondary	2,700	405	secondary	2,700	405
Morven	--	--	--	secondary	1,000	150
Nashville	secondary	5,400	810	secondary	8,000	1,200
Naylor	--	--	--	secondary	800	120
Norman Park	secondary	1,200	180	secondary	2,200	330
Ocilla	secondary	4,200	630	secondary	6,200	930
Omega	secondary	1,350	200	secondary	2,100	315
Pavo	secondary	1,150	170	secondary	2,000	300
Pitts	--	--	--	secondary	1,000	150

(6/1/62)

TABLE P-5 (CONT'D)
SOURCES OF MUNICIPAL SEWAGE - 1975 AND 2000
SUWANNEE BASIN

	1975			2000		
Municipality	Treatment Recommended	PE Untreated Waste	PE Discharged Waste	Treatment Recommended	PE Untreated Waste	PE Discharged Waste
GEORGIA - cont'd						
Poulan	secondary	1,200	180	secondary	2,300	345
Quitman	secondary	26,200	3,930	secondary	29,500	4,430
Ray City	secondary	850	125	secondary	1,600	240
Rochelle	secondary	1,650	250	secondary	2,400	360
Sparks	secondary	1,525	230	secondary	2,400	360
Statenville	--	--	--	secondary	1,200	180
Sycamore	secondary	850	125	secondary	1,600	240
Sylvester	secondary	4,800	720	secondary	7,000	1,050
Tifton	secondary	16,500	2,480	secondary	24,400	3,660
Ty Ty	--	--	--	secondary	1,200	180
Valdosta	secondary	52,500	7,880	secondary	83,000	12,450
Willacoochee	secondary	1,400	210	secondary	2,200	330
Totals		221,725	38,080		330,600	53,860

(6/1/62)

TABLE P-6
SOURCES OF INDUSTRIAL WASTE - 1975 AND 2000
(Excludes industries connected to municipal sewer systems)
SUWANNEE BASIN

Location by State and County	Code	Treatment Recommended	1975			2000		
			Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste	Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste
FLORIDA								
Alachua	A	stab pond	0.312	31,200	4,700	0.710	71,000	7,000
Bradford	C	chem precip	6.170	undet	undet	10.800	undet	undet
Clay	D	chem precip	8.200	undet	undet	14.400	undet	undet
Dixie	E	chem precip	0.315	undet	undet	0.472	undet	undet
	F	chem precip	0.378	undet	undet	0.566	undet	undet
Madison	G	chem precip	0.002	--	--	0.003	--	--
GEORGIA								
Ben Hill	D	stab pond	0.026	undet	undet	0.030	undet	undet
	E	chem precip	0.013	undet	undet	0.018	undet	undet
Brooks	F	stab pond	0.062	3,100	470	0.142	7,100	1,060
	New[1]	stab pond	0.075	7,500	1,100	0.280	28,000	4,200
	New[1]	primary	0.014	3,200	2,100	0.052	12,000	7,800
	New[2]	primary	0.380	2,350	1,500	0.760	4,700	3,000
Clinch	G	chem precip	0.025	undet	undet	0.036	undet	undet
Colquitt	H	holding lagoon	0.002	--	--	0.002	--	--
	I	stab pond	1.100	49,300	7,400	2.500	112,000	16,900
	J	pH adjust	0.610	--	--	1.690	--	--
	K	holding lagoon	0.002	--	--	0.002	--	--
	L	pH adjust-settling lagoons	0.350	--	--	0.350	--	--
Cook	A	ion exchange	0.138	--	--	0.333	--	--
Lowndes	C	bio-oxidation lagoons	10.400	227,000	34,000	17.400	405,000	61,000
	W	stab pond	0.057	2,700	400	0.136	6,450	970
	X	chem precip	0.177	undet	undet	0.270	undet	undet
	Z	primary	0.009	1,650	1,070	0.021	3,800	2,470
	AA	chem precip	0.012	undet	undet	0.018	undet	undet
	BB	pH adjust	0.024	--	--	0.065	--	--

(6/1/62)

TABLE P-6 (CONT'D)
SOURCES OF INDUSTRIAL WASTE - 1975 AND 2000
(Excludes industries connected to municipal sewer systems)
SUWANNEE BASIN

			1975			2000		
Location by State and County	Code	Treatment Recommended	Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste	Vol. of Waste mgd	PE Untreated Waste	PE Discharged Waste
GEORGIA - Cont'd								
Tift	New[1]	stab pond	0.030	3,000	450	0.110	11,000	1,650
	Q	oil removal	0.001	--	--	0.002	--	--
	R	chem precip	0.025	undet	undet	0.033	undet	undet
	S	pH adjust	0.044	--	--	0.110	--	--
Worth	N	stab pond	0.001	undet	undet	0.001	undet	undet
	O	stab pond	0.017	3,200	480	0.028	5,250	790
Totals			28.971	334,200	53,670	51.340	666,300	106,840

[1] Canning
[2] Poultry

(6/1/62)

TABLE P-7
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED COSTS* - 1975 AND 2000
SUWANNEE BASIN

	Estimated Costs in $1,000					
	1975			2000		
Municipality	Sewerage	Treatment	Total	Sewerage	Treatment	Total
FLORIDA						
Alachua	24	--	24	28	103	131
Branford	50	103	153	50	103	153
Cherry Lake	--	--	--	40	140	180
Chiefland	25	--	25	23	88	111
Cross City	7	--	7	20	88	108
Greenville	24	--	24	30	115	145
Hampton	--	--	--	50	166	216
High Springs	9	--	9	25	67	92
Jasper	10	--	10	13	--	13
Jennings	40	134	174	33	--	33
Lake Butler	22	--	22	28	103	131
Lake City	112	--	112	100	316	416
Lawtey	45	185	230	15	--	15
Live Oak	73	--	73	100	545	645
Madison	13	--	13	25	103	128
Mayo	45	134	179	30	--	30
Melrose	43	185	228	17	--	17
Newberry	17	--	17	8	--	8
Olustee	--	--	--	55	174	229
Raiford	--	--	--	68	207	275
Shamrock	43	147	190	40	140	180
Starke	35	166	201	75	219	294
Trenton	13	--	13	20	88	108
Waldo	8	--	8	20	88	108
Wellborn	--	--	--	63	194	257
White Springs	21	--	21	38	202	240
GEORGIA						
Adel	54	--	54	125	316	441
Alapaha	8	--	8	35	19	54
Anabi	--	--	--	50	23	73
Ashburn	50	166	216	100	268	368
Barwick	--	--	--	60	27	87
Berlin	--	--	--	48	22	70
Chula	--	--	--	40	20	60
Ellenton	--	--	--	45	22	67
Enigma	--	--	--	60	27	87

TABLE P-7 (CONT'D)
MUNICIPAL POLLUTION ABATEMENT
ESTIMATED COSTS* - 1975 AND 2000
SUWANNEE BASIN

	Estimated Costs in $1,000					
	1975			2000		
Municipality	Sewerage	Treatment	Total	Sewerage	Treatment	Total
GEORGIA - Cont'd						
Fargo	15	--	15	57	25	82
Fitzgerald	146	78	224	265	82	347
Hahira	20	--	20	40	20	60
Homerville	43	140	183	75	219	294
Lakeland	38	--	38	70	363	433
Lake Park	--	--	--	40	20	60
Lenox	17	--	17	48	22	70
Morven	--	--	--	50	23	73
Nashville	67	218	98	130	415	545
Naylor	--	--	--	40	20	60
Norman Park	15	--	15	50	23	73
Ocilla	46	166	212	100	267	367
Omega	21	--	21	37	16	53
Pavo	17	--	17	43	20	63
Pitts	--	--	--	50	23	73
Poulan	60	43	103	55	--	55
Quitman	82	800	882	165	415	580
Ray City	7	--	7	37	20	57
Rochelle	21	174	195	37	--	37
Sparks	18	--	18	44	22	66
Statenville	--	--	--	60	27	87
Sycamore	43	32	75	37	--	37
Sylvester	60	--	60	110	267	377
Tifton	50	--	50	325	665	990
Ty Ty	--	--	--	60	27	87
Valdosta	517	1151	1668	1200	1950	3150
Willacoochee	17	--	17	40	20	60
Totals	2,111	4,230	6,341	4,842	8,928	13,770

*Based on January 1960 constant dollars.

TABLE P-8
INDUSTRIAL POLLUTION ABATEMENT ESTIMATED COSTS* - 1975 AND 2000
SUWANNEE BASIN

Location by State and County	Code	Estimated Costs in $1,000	
		1975	2000
FLORIDA			
Alachua	A	50	133
Bradford	C	35	128
Clay	D	85	164
Dixie	E	5	16
	F	10	16
GEORGIA			
Ben Hill	F	8	18
Brooks	New[1]	47	58
	New[1]	121	161
	New[2]	100	60
Cinch	F	--	5
Colquitt	I	43	116
	J	21	79
Cook	A	17	122
Lowndes	C	115	355
	W	7	18
	X	4	10
	Z	20	60
	AA	--	5
	BB	--	5
Tift	New[1]	26	34
	Q	--	5
	R	--	5
	S	5	10
Worth	O	12	9
Totals		731	1592

[1] Canning
[2] Poultry

* Based on January 1, 1960 constant dollars.

(6/1/62)

By the year 2000, there will be a need for sewerage construction in 62 municipalities. These municipalities will require extension of the sewage collection systems recommended in 1960 and 1975 to serve an additional 96,840 persons. As shown in Table P-7, the total outlay required for extension of the sewage collection systems required to meet the needs by the year 2000 is estimated to be $4,842,000.

TREATMENT FACILITIES

The degree of treatment required at each municipality, institution, and industry has been determined on the basis of dilution water available during periods of low stream flow and/or downstream water use. In the upstream areas where low flows are not sufficient to protect water quality after secondary treatment, low flow augmentation is recommended. However, primary treatment only has been recommended for wastes discharged to tidewater. These areas are discussed more fully in the LOW FLOW AUGMENTATION section of this memorandum.

The sewage treatment facilities recommended for 1960 will be adequate to meet the 1975 needs in 24 municipalities and institutions. Seven other municipalities, however, will need to enlarge either their existing treatment facilities or those recommended for 1960 to meet 1975 needs. Eight municipalities will need to construct new treatment plants; 3 primary, 3 secondary , and 2 stabilization ponds. The total capital outlay required for municipal sewage treatment plant construction by 1975 is estimated to be $4,230,000 as shown in Table P-7.

Existing treatment facilities or those recommended for 1960 will be adequate to meet 1975 needs for 12 industries. However, 15 industries will need additional waste treatment facilities by 1975. In addition, the 4 new industries projected for the Basin will need to construct new treatment facilities by 1975. The total capital outlay required for this construction is estimated to be $731,000 as shown in Table P-8.

Sewage treatment facilities recommended for 12 municipalities for 1975 will need to be enlarged to meet 2000 needs. In addition, 22 municipalities will need to enlarge their existing or recommended 1960 plants and 19 municipalities will need to construct new plants or add secondary units to primary plants to meet 2000 needs. The total capital outlay required for municipal sewage treatment facilities needed by 2000 is estimated to be $8,928,000 as shown in Table P-7.

The waste treatment facilities recommended for the 19 industries for 1975 will need to be expanded to meet 2000 needs. In addition, other industries will need to expand existing facilities or those recommended for 1960. The total capital outlay required for this expansion is estimated to be $1,592,000 as shown in Table P-8.

LOW FLOW AUGMENTATION

GENERAL

A minimum standard of water quality for fish and aquatic life is a dissolved oxygen content of not less than 4 ppm. In determining the volume of stream flow and storage required to maintain this standard, the following assumptions were used:

1. Summer water temperatures.
2. Minimum flows are 7-day low flows occurring once in 10 years.
3. Physical characteristics and reaeration constant of streams vary as to location, size, etc. of stream.

Minimum stream flows required at locations in the Basin where liquid wastes are discharged were calculated on the basis of the estimated PE for the years 1960, 1975, and 2000. At least primary treatment was assumed for all locations, and if the required dilution flow exceeded the actual low flow, secondary treatment was recommended. The minimum flows are shown in Table P-9. Locations requiring minimum flows of less than 1.0 cfs by the year 2000 are not included in the table.

AREAS WHERE AUGMENTATION IS NOT NEEDED

There will be sufficient volumes of water available for adequate dilution, and no storage will be needed to maintain stream quality below the points of discharge (after recommended treatment) from the following areas: Branford, Cedar Key, High Springs, and White Springs in Florida; and Lakeland and Valdosta in Georgia.

AREAS WHERE AUGMENTATION IS NEEDED

In several areas, the streams receiving wastes travel a short distance (1 to 5 miles) before reaching a larger stream with adequate flow. This results in polluted stream conditions for short distances during periods of low stream flow in the following areas: Jennings, Mayo, Raiford, and Raiford State Prison in Florida; and, Homerville, and Quitman, Georgia. Storage for augmentation of low flow or a higher degree of treatment is not considered to be the most economical solution to these pollution problems because of the short stream distances involved. Studies of alternate solutions such as diversion, will be needed in these areas.

Waste discharges to other areas in the Basin will present greater problems, however, and are discussed individually below:

TABLE P-9
MINIMUM FLOW REQUIREMENTS
SUWANNEE BASIN

General Location	Receiving Stream	Water Required (cfs)		
		1960	1975	2000
FLORIDA				
Alachua[1]	Santa Fe River	6.6	10.1	22.2
Branford[1]	Suwannee River	--	6.0	12.0
Cedar Key[5]	Waccasassa Bay-Gulf of Mexico	9.6	7.2	5.8
Chiefland[1]	br-Suwannee River	0.4	0.6	1.0
Cross City[1]	swamp-Suwannee River	0.5	0.6	1.0
High Springs[1]	Santa Fe River	5.8	6.0	7.2
Jennings[1]	Alapaha River	--	1.9	3.6
Lake City[4]	Alligator Lake	--	--	--
Madison	swamp-Suwannee River	1.0	1.1	1.2
Mayo[1]	br-Suwannee River	--	2.2	3.6
Raiford State Prison	New R-Santa Fe River	1.0	1.5	1.5
Starke	Alligator Cr-Santa Fe River	1.4	1.6	2.1
White Springs[3]	Suwannee River	1.5	2.4	0.5
GEORGIA				
Adel-Sparks	Bear Cr-Withlacoochee R	1.6	2.1	3.0
Ashburn-Sycamore	Little River	0.5	0.7	1.2
Clyattville (Ind)	Withlacoochee River	51.0	68.0	121.0
Fitzgerald	Turkey Cr-Willacoochee River	3.7	6.0	10.0
Homerville	Savior's Cr-Okefenokee Swamp	0.8	1.0	1.5

(6/1/62)

TABLE P-9 (CONT'D)

General Location	Receiving Stream	Water Required (cfs)		
		1960	1975	2000
GEORGIA - Cont'd				
Lakeland[3]	Big Cr-Alapaha River	5.3	7.2	1.3
Moultrie (Ind)	Okapilco Cr	9.4	16.4	40.7
Nashville	Ready Cr-Withlacoochee River	1.2	1.9	3.1
Ocilla	Stump Cr-Willacoochee River	1.0	1.3	1.9
Quitman[2]	Okapilco Cr	58.8	10.1	17.3
Sylvester-Poulan	Warrior Cr-Little River	1.7	2.4	4.2
Tifton	New River	1.5	--	--
Tifton	Little River	2.4	5.8	10.6
Valdosta[6]	Sugar Cr-Withlacoochee River	18.6	29.7	28.9

[1] Primary treatment only
[2] Should provide secondary treatment by 1975
[3] Should provide secondary treatment by 2000
[4] Discharge to reservoir (secondary treatment)
[5] Discharge to tidewater (primary treatment)
[6] Primary treatment of industrial wastes until 2000

Lakes and Reservoirs

Wastes from Lake City, Stark, and several smaller towns in Florida are discharged directly to lakes or reservoirs. Secondary treatment for all such wastes has been recommended as a desirable minimum, but no attempt has been made to determine augmentation requirements. Alleviation of pollution in lakes and reservoirs would better be accomplished by wastes dispersion through properly designed outfalls and/or a high degree of treatment.

Alachua, Florida

There are no streams near Alachua suitable for disposal of wastes. To avoid degradation of the nearby lakes and sinks, the wastes could be discharged by pipeline or canal approximately 7 miles to the Santa Fe River near High Springs where the natural low flow is ample to maintain water quality.

Chiefland, Florida

There are no streams near Chiefland suitable for disposal of wastes. To avoid degradation of the nearby lakes and sinks, the wastes could be discharged by pipeline or canal approximately 7 miles to the Suwannee River where the natural low flow is ample to maintain water quality.

Cross City, Florida

There are no streams near Cross City suitable for disposal of wastes. To avoid degradation of the nearby lakes and sinks, the wastes could be discharged by pipeline or canal approximately 9 miles to the Suwannee River where the natural low flow is ample to maintain water quality.

Madison, Florida

Wastes from Madison are discharged, after secondary treatment, to a swamp where little or no natural flow is available. Although pollution of the swamp will occur, the wastes should be stabilized by natural processes before reaching the Suwannee River. Pollution of the swamp could be avoided by discharging the wastes by pipeline or canal approximately 8 miles directly to the Suwannee River where the natural flow is ample to maintain water quality.

Adel-Sparks, Georgia

Wastes from Adel and Sparks are discharged to Bear Creek where there is insufficient drainage area to provide adequate flow or storage for augmentation during periods of low flow. Bear Creek will be polluted for several miles to its confluence with the Withlacoochee River where the natural low flow is 1 cfs. Storage on the Withlacoochee

River upstream from Bear Creek should be provided to avoid degradation of water quality. Estimated storage requirements are 350 acre-feet and 700 acre-feet in 1975 and 2000, respectively.

Ashburn-Sycamore Area, Georgia

Wastes from this area are discharged to the headwater of Hat Creek and to the Little River. There is insufficient drainage area on Hat Creek to provide adequate dilution water or storage for augmentation during periods of low flow. To avoid degradation of Hat Creek for 15-20 miles during low flow, all wastes should be discharged to the Little River. The storage capacities required to maintain adequate low flow in the Little River are 280 acre-feet, 400 acre-feet, and 640 acre-feet in 1960, 1975, and 2000 respectively.

Clyattville, Georgia

Industrial wastes from the Clyattville area are discharged after secondary treatment to the Withlacoochee River at a point where the natural low flow is approximately 60 cfs. For adequate dilution, the wastes require 51.0 cfs, 68.0 cfs, and 121.0 cfs in 1960, 1975, and 2000 respectively.

Storage at some suitable site upstream to provide an additional flow of approximately 60 cfs by the year 2000 would be desirable to avoid degradation of the Withlacoochee River during periods of low flow. The amount of storage required would be considerable and other solutions such as holding lagoons or diversion should be considered before storage for low flow augmentation is provided.

Fitzgerald, Georgia

Wastes from Fitzgerald are discharged to several small creeks at the headwaters of the Willacoochee River. There is insufficient drainage area to provide adequate dilution water or storage for augmentation during periods of low flow. As a result the Willacoochee River will be polluted for many miles during periods of low flow to a point where the wastes become stabilized by natural processes. Degradation of the Willacoochee River could be avoided by pumping the wastes to other creeks to the north of town which drain approximately 9 miles to the Ocmulgee River. However, other creeks would be polluted during periods of low flow.

Moultrie, Georgia

A portion of the wastes from Moultrie are discharged to Okapilco Creek at a point where the natural low flow is approximately 0.1 cfs. The wastes require, after secondary treatment, 9.4 cfs, 16.4 cfs, 40.7 cfs in 1960, 1975, and 2000, respectively. There is insufficient watershed area above the point of discharge to develop storage for low flow augmentation. To avoid degradation of Okapilco Creek, the wastes could be pumped to the Ochlockonee River. Storage for low flow augmentation needed on the Ochlockonee River is given in the Technical Memorandum for the Ochlockonee Basin.

Nashville, Georgia

Wastes from Nashville are discharged to the Withlacoochee River at a point where the natural low flow is approximately 0.3 cfs. The wastes require, after secondary treatment, 1.2 cfs, 1.9 cfs, and 3.1 cfs in 1960, 1975, and 2000 respectively. The storage capacities required on the Withlacoochee River above the point of discharge are 240 acre-feet, 480 acre-feet, and 840 acre-feet in 1960, 1975, and 2000 respectively.

Ocilla, Georgia

Wastes from Ocilla are discharged to Stump Creek where there is insufficient drainage area to provide adequate dilution water or storage for augmentation during periods of low flow. As a result, Shrimp Creek and the Willacoochee River will be polluted for several miles during low flow to a point where the wastes have been stabilized by natural processes.

Sylvester-Poulan, Georgia

Wastes from this area are discharged to Warrior Creek where there is insufficient drainage area to provide adequate dilution water or storage for augmentation during periods of low flow. As a result, Warrior Creek will be polluted for about 20 miles.

Tifton, Georgia

Wastes from Tifton are discharged to both the New River and Little River. At the point of discharge to the New River there is little, if any natural low flow and insufficient drainage to provide storage. To avoid degradation of the New River, all wastes should be discharged to the Little River.

The natural low flow in the Little River at Tifton is approximately 0.5 cfs. The storage capacities required on the Little River above the point of discharge are 1050 acre-feet, 1650 acre-feet, and 2900 acre-feet in 1960, 1975, and 2000 respectively.

SUMMARY OF AUGMENTATION NEEDS

The areas in the Suwannee Basin where storage for low flow augmentation is needed is shown below.

TABLE P-10
RESERVOIR STORAGE NEEDS
SUWANNEE BASIN

Location	Storage Acre-Feet 1960	 1975	 2000
Alachua, Florida	Diversion of wastes		
Chiefland, Florida	Diversion of wastes		
Cross City, Florida	Diversion of wastes		
Jennings, Florida	Not economically feasible		
Madison, Florida	Diversion of wastes		
Mayo, Florida	Not economically feasible		
Raiford, Florida	Not economically feasible		
Adel-Sparks, Georgia	--	350	700
Ashburn-Sycamore, Georgia	280	400	640
Clyattville, Georgia	See text		
Fitzgerald, Georgia	Diversion of wastes		
Homerville, Georgia	Not economically feasible		
Moultrie, Georgia	Diversion of wastes		
Nashville, Georgia	240	480	840
Ocilla, Georgia	Insufficient drainage area		
Quitman, Georgia	Not economically feasible		
Sylvester-Poulan, Georgia	Insufficient drainage area		
Tifton, Georgia	1050	1650	2900

ANNUAL COSTS AND BENEFITS

FINANCING

Municipalities can finance sewage works construction by general obligation bonds, revenue bonds, special assessments, or some combination of these methods. The Georgia law permits the issuance of general obligation bonds to be repaid within 30 years, up to a maximum amount of 7 percent of the evaluation of taxable property within the political sub-division. The law permits an increase of this bonded indebtedness of 3 percent of the evaluation of the taxable property provided the increased indebtedness shall be repaid within a five-year period and is approved by the General Assembly.

The Florida law permits issuance of general obligation bonds up to a maximum amount of 10 percent of the evaluation of taxable property within the political sub-division. Individual exceptions to this law have been made by the legislature.

Georgia law authorizes the State to make grants to any county or municipality if funds are available to assist in pollution abatement projects that qualify for Federal aid under Public Law 660. The State grants are limited to 30 percent of that portion of the construction costs which qualify under the Federal aid program or $250,000 whichever is smaller. To date, however, no grants have been made by the State.

Financial aid is available to municipalities in the form of Federal grant assistance under Public Law 660 as amended. The Federal Government will pay up to 30 percent of the estimated reasonable cost of construction of municipal sewage treatment works or $600,000, whichever is smaller. Eligible for assistance are construction of new treatment works, improvements to existing treatment facilities, intercepting sewers, outfall sewers, pumping, and such preliminary planning necessary for construction. To date, Moultrie, Georgia and Live Oak, Florida have participated in the Federal aid program constructing both interceptor sewers and/or sewage treatment plants and appurtenant works. The project at Moultrie is still under construction.

Industries will undoubtedly finance their pollution abatement facilities with private capital by the most economical methods available to them at the time of construction.

ANNUAL COSTS FOR 1960

The annual cost of pollution abatement by municipalities and industries in the Basin in 1960 is estimated to be $976,600. This includes the annual equivalent capital cost of existing facilities in 1960, annual replacement, and operation and maintenance cost of existing facilities. A breakdown of the total annual cost is shown below:

	Municipal	Industrial
Annual equivalent capital cost	$648,600	$37,100
Annual replacement cost	0	9,900
Annual operation and maintenance cost	242,800	38,200
Total annual cost (1960)	$891,400	$85,200

The total capital outlay required to improve existing pollution abatement facilities to meet the 1960 needs is estimated to be $8,560,000 for 35 municipalities and $503,000 for 22 industries. These costs are shown in Tables P-3 and P-4.

ANNUAL COSTS BY 1975

The total capital outlay required for additional pollution abatement facilities needed by 1975 after 1960 needs have been met, is estimated to be $6,341,000 for 45 municipalities and $731,000 for 19 industries. These costs are shown in Tables P-7 and P-8.

The total annual cost of pollution abatement by municipalities and industries in 1975 is estimated to be $2,074,800. This includes the annual equivalent capital cost of (1) existing facilities in 1960 (2) facilities recommended to meet 1960 needs, and (3) facilities recommended to meet 1975 needs. The replacement cost is based on the total investment by 1975 and the operation and maintenance cost is based on existing and recommended facilities as of 1975. A breakdown of total annual cost is shown below:

	Municipal	Industrial
Annual equivalent capital cost	$1,352,300	$116,200
Annual replacement cost	0	25,500
Annual operation and maintenance cost	461,400	119,400
Total annual cost (1975)	$1,813,700	$261,100

ANNUAL COSTS BY 2000

The total capital outlay required for additional pollution abatement facilities needed by the year 2000 is estimated to be $13,770,000 for 62 municipalities and $1,592,000 for 24 industries. These costs are shown in Tables P-7 and P-8.

The total annual cost of pollution abatement by municipalities and industries in 2000 is estimated to be $2,946,700. This includes the equivalent capital cost, the replacement cost, and the operation and maintenance cost of existing facilities and all recommended improvements for 1960, 1975, and 2000. A breakdown of total annual cost is shown below:

	Municipal	Industrial
Annual equivalent capital cost	$1,849,400	$202,900
Annual replacement cost	0	44,100
Annual operation and maintenance cost	644,400	205,900
Total annual cost (2000)	$2,493,800	$452,900

BENEFITS

It is recognized that pollution control results in benefits to public health and to those economic activities associated with the use of water of improved quality. However, because there is no established market value for water, as a commodity sold in a competitive market, monetary benefits from improvement in quality of water now used or anticipated to be used in the future, from public or private supplies, in the Suwannee Basin are indeterminate. While pollution abatement does enhance fishing and recreational opportunities, protect health, preserve and improve property and aesthetic values, and assure future utility of water resources, these values are confined largely to the intangible or social realm.

Ordinarily for those functions for which no market values are clearly established their values may in some cases be derived or estimated indirectly from prices established in the market for similar or analagous effects or may be derived from the most economical cost of producing similar effects by an alternative means. In the case of pollution abatement, however, there are no established prices for similar effects since no analagous effect exists. Neither are there alternative means of providing similar effects since, in most cases, the most likely, least cost means of attaining the desired effects is used. Therefore, lacking adequate methodology for assessing social values, benefits from pollution abatement must, for the time being, be considered as intangible. In the absence of established or synthetic market values, since the benefits from pollution abatement are real although intangible, it is considered that benefits accruing from pollution control by conventional treatment processes are at least equal to the cost of providing the facilities.

Since knowledge of society's future needs is less complete and accurate than information of present requirements, there could well be a tendency to adopt a water quality standard that is at times too high. Such has not been the case in the development of costs in this memorandum, however, because only minimum requirements or needs have been expanded into the future.

SUMMARY

1960

At the present time there are 27 municipalities (which include 5 institutions) and 30 industries which discharge wastes, treated and untreated, into the surface waters of the Suwannee Basin.

The total volume of municipal and industrial wastes discharged to the waters of the Basin is estimated to be 29.7 mgd and the total PE 365,800 untreated and 107,800 after treatment.

The existing (1960) total annual cost of pollution abatement by municipalities and industries in the Basin is estimated to be $976,600.

1975

By 1975, 48 municipalities and institutions and 31 industries are expected to discharge wastes to the surface waters of the Suwannee Basin. The total PE of these wastes is estimated to be 555,900 before treatment and 91,800 after recommended treatment.

Reservoir storage for low flow augmentation will be needed in 3 areas in 1975. In 2 areas, receiving streams will not have sufficient drainage area to allow storage for low flow augmentation and thus polluted water conditions will exist during natural low flow periods several miles downstream. In 4 areas, the size and length of the receiving streams is such that low flow augmentation during periods of low flow would not be economically feasible and thus severely polluted conditions are expected to exist for short distances downstream. Diversion of wastes to other streams either within or outside the Basin appears practicable and should be considered in 7 areas.

The total annual cost of pollution abatement by municipalities and industries by 1975 is estimated to be $2,074,800. This total includes the cost of existing facilities and those needed to meet existing (1960) and projected 1975 needs.

2000

By 2000, 65 municipalities and institutions and 31 industries are expected to discharge wastes to the surface waters of the Suwannee Basin. The total PE of these wastes is estimated to be 996,900 before treatment and 160,700 after recommended treatment.

Reservoir storage will be needed in 4 areas in the Basin by 2000. As in 1975, 2 areas which have insufficient drainage area to allow storage will be polluted downstream and in 4 other areas low flow augmentation will not be economically feasible and thus polluted conditions are expected to exist in localized areas.

The total annual cost of pollution abatement by municipalities and industries by 2000 is estimated to be $2,946,700. This value includes the cost of existing facilities and those needed to meet existing (1960) and projected 1975 and 2000 needs.

PUBLIC HEALTH

INTRODUCTION

This Technical Memorandum is written with the limitation that field data were not available for all phases. Presentation of data in the subject areas of Vector Control and Solid Wastes is based upon published material and on field studies done by the Communicable Disease Center of the Public Health Service. The information is general and portions cannot be applied specifically to the Basin, but their presentation will serve as a guide to the solution of Basin problems as well as broader State and Regional problems.

(6/1/62)

VECTOR CONTROL

INTRODUCTION

Vector problems and control efforts in the Suwannee Basin may be subdivided into two segments--urban and rural. In this study, selected towns in the Basin over 1,000 population were grouped into the urban setting. Most Florida counties in the Basin have vector control programs centered in towns which are primarily concerned with the control of mosquitoes and secondarily, with flies, rats, and other vectors. In the rural areas, vector problems (except for 5- to 10-mile range freshwater flood mosquitoes) are mostly associated with the activities of the farmer who solves them on an individual basis. Exceptions to these are in the mosquito control work in the following Florida counties: Levy, Bradford, Madison, and Suwannee. However control efforts in these counties are centered in and around urban areas. There are countywide rodent control programs in the following Georgia counties: Lowndes and Colquitt.

For long-range planning concerning land and water uses, emphasis has been given to recommendations that would result in an environment by the years 1975 and 2000 that will require only a minimum of repetitive pesticide application. This will not only minimize the cost of vector control programs to the public but will make them more effective.

EXISTING VECTOR PROBLEMS

Eastern encephalitis ("sleeping sickness") has caused serious losses among horses in the Basin. Mosquito vectors of this highly fatal human and horse disease are most prevalent in the swamps and marshes located close to and along the coast.

In recent years primary local malaria transmission has been at extremely low levels. The number of malaria mosquitoes, Anopheles quadrimaculatus, remains about the same in the Basin as in years when malaria was prevalent. Therefore, as long as travelers bring malaria parasites back to this country from malarious areas of the earth, there will remain a danger of malaria transmission. The continuance of mosquito control efforts coupled with surveillance will still be required for many years. Fresh-water pools and ponds with vegetation are favorite breeding places of malaria mosquitoes.

Typhus fever (flea-borne) was a severe problem in Georgia and Florida during the 1930's and 1940's. During recent years, improved sanitation practices (limiting the domestic rat's food and harborage) and the use of newer rat poisons and flea insecticides have reduced transmission of this disease to low levels. In 1959, only eight cases of typhus were reported in Georgia. The pest control industry has played an important role in halting typhus transmission in the urban setting. Most of the remaining transmission of this disease appears to take place in rural areas.

There is considerable transmission of various enteric infections by houseflies. Determination of precise case rates is difficult because of many factors, including poor reporting, difficulties with diagnosis and patients not seeking medical help.

Rocky Mountain spotted fever occurs occasionally in Georgia and Florida. An average of 23 cases per year was reported in Georgia during the period 1955-59. Increased use and number of recreational areas and construction of outlying suburban housing areas appear to increase the possibility of American dog ticks transmitting Rocky Mountain spotted fever to humans. It is noteworthy that in the eastern United States the incidence of this disease has been highest among vacationists and picnickers, particularly among women and children.

Conjunctivitis (pink eye), a common disease of younger children, is confined largely to rural areas of the Basin. One mode of transmission of this disease is by eye gnats (Hippelates). Oviposition of these insects occurs in freshly cultivated or otherwise disturbed soil.

The coastal area of the Suwannee Basin with its tidal marshlands is notorious for biting insects. In this area, salt-marsh mosquitoes occur in large numbers and cause great annoyance to the residents and visitors to recreational areas. At times, these mosquitoes occur in such overwhelming numbers that outdoor activities during the day or night are practically impossible. Large broods of salt-marsh mosquitoes frequently occur following unusually high tides or heavy rains.

Fresh-water swamps, marshes, and low-lying areas that receive floodwater are also important sources of mosquitoes.

Throughout the Basin, numerous small patches of alligatorweed and water hyacinths are found in small ditches and drainage creeks. Both of these obnoxious weeds were introduced into the United States from tropical areas and are spreading except in places where control work is being effected. Profuse growths of these weeds tend to clog drainage ditches, canals, ponds, etc., creating conditions favorable for malaria mosquitoes. Many other aquatic plants are profusely present, especially in the Florida portion of the Basin. Federal programs exist which plan for the eradication of obnoxious weeds.

(6/1/62)

In urban areas, vector problems are frequently associated with improper disposal of sewage. Severe Culex mosquito problems have developed in the past where communities discharged improperly treated sewage wastes into swampy or impounded areas near town. In about 35 percent of the towns studied, overflowing septic tanks are a problem, and create ideal places for the breeding of mosquitoes. A few waste stabilization ponds are beginning to appear in portions of the Basin, and they could cause mosquito breeding problems unless they are properly operated and maintained free from weeds.

About 30 percent of the homes in the urban areas do not meet minimum sanitation standards and thus have associated fly, rat, and mosquito problems. The city of Valdosta has a minimum housing standards program centered in the Health Department. In 1½ years, 170 dwelling units have been brought up to standard, and there are 750 additional sub-standard dwelling units on which work is being done. Other local directors of sanitation are also aware of vector problems in substandard housing.

Management of water in rural areas gives rise to a variety of insect vector problems. Inadequacies of general drainage construction and maintenance contribute to mosquito breeding. Most small creeks, canals, and drainage ditches receive little or no maintenance. Frequently, individual farmers and towns are not able to construct the small drainage ditches because of the lack of or clogging of large drainage canals in the county system.

Mosquito breeding in farm ponds in Georgia portions of the Basin has not been serious due to the present construction and operating procedures. Farm ponds in Florida have considerable aquatic vegetation, and thus afford environmental conditions favoring much mosquito breeding.

Irrigation (sprinkler type) is increasing in the Suwannee Basin. It is used principally during periods of dry weather for such crops as tobacco and corn, and also for pasture lands. No significant mosquito problems have developed from the proper application of irrigation water to fields.

Artesion wells originating in the limestone aquifer frequently produce an alkaline water that is very favorable for the production of malaria mosquitoes. Although some of these flowing wells exist in the Basin, little information is available concerning mosquito production associated with them.

Vector problems associated with land resource activities include those related to the production of livestock and poultry.

Hog parlors are beginning to appear in the Southeastern States, and several have appeared in this Basin. A common practice in these parlors is to wash waste accumulations from the concrete floors into an open septic tank. The overflow often discharges into the nearest low, swampy area. This method of disposal frequently causes heavy housefly breeding. Rat infestation is also associated with hog parlor operations.

Chicken "factories" are also appearing in the Southeast and in this Basin. In these egg factories, the birds are usually kept in small elevated cages, beneath which cones of manure accumulate on dirt floors. Severe fly and rodent problems frequently develop where there is poor housekeeping. In another type of egg and chicken factory, the chickens are kept on a deep bed of wood shavings which is removed only occasionally. Waste chicken feed from power conveyors plus the accumulation of manure creates favorable breeding places for flies.

The accumulation of solid waste material (principally manure) on farms is increasing. There is no easy solution for sanitary disposal of these wastes without creating fly problems. The spreading of such wastes on fields at frequent intervals is frequently very difficult because of crop growing and manpower requirements. Dairy barn liquid wastes when allowed to discharge into nearby pastures sometimes give rise to mosquito problems.

Many fire ant mounds were noted in the lower portion of the Basin. Fire ant stings, although not commonly experienced by humans, may be very severe. Fire ant mounds are not only unsightly but they are detrimental to agricultural operations. When chemical control programs are used care should be taken to protect wildlife and water supplies.

STATUS OF EXISTING PROGRAMS

There is no statewide enabling legislation for mosquito or other vector control districts in Georgia. Adequate legislation of this nature does exist in Florida.

Both Georgia and Florida have specific health regulations pertaining to the impounding of water. Permits are issued for the construction of farm ponds built to comply with State Board of Health regulations. One County Health Department Sanitarian stated that most farm ponds in his area were constructed in low swampy areas that used to breed many mosquitoes and that the construction of farm ponds greatly reduced mosquito annoyance in the area.

Supportive services for vector control operations include:

1. Surveillance. Health agencies are concerned with a continuing analysis of vector problems to guide the efforts of other

activities.

2. Research. The Florida State Board of Health has a large Entomological Research Center at Vero Beach, Florida which is working on the control of insects affecting human health. Research on vector control is also being carried on at two Federal stations in the Southeast--the Orlando, Florida Laboratory of the Entomology Research Division (USDA) and the Technical Development Laboratories of the Communicable Disease Center (PHS), Savannah, Georgia. In Pensacola, Florida, the Public Health Service, in cooperation with the involved State and local health departments, is attempting to eradicate the yellow fever mosquito, Aedes aegypti. Now in its third year of operation, the project is making excellent progress toward the eradication goal. Public education, environmental sanitation, and DDT residual premises spraying methods are being utilized.

3. Technical assistance. Health agencies provide technical assistance to construction and operating agencies in planning and carrying out vector control operations. Local sanitarians give technical advice and assistance to local communities and to individuals.

Present vector control programs in the Basin consist of 4 countywide mosquito control programs centered in health departments, 2 countywide rodent control programs, and several municipal mosquito programs. Most of the mosquito control activities are limited to adulticiding measures.

EXISTING NEEDS

There is a need for more emphasis to larviciding and permanent control measures. Each county needs at least one dragline for mosquito control work. Towns in the district should have from one to several year-round mosquito control workers who would inspect for larvae during the mosquito season, apply larvicides to mosquito breeding areas, operate adulticiding machines occasionally when large mosquito infestations occur, and do maintenance and minor ditch construction during winter months.

Mosquito control districts are needed in the coastal counties of Dixie and Levy, Florida. Each district should have one dragline at the beginning of the control program and work up to 3 units in the future after the counties have become more fully developed economically.

Studies in the Basin indicate that every county should have at least one man full-time to work with farmers on rodent control. The economic saving to farmers would pay his salary and expenses several times over and would help guard against any possible resurgence of murine typhus fever.

(6/1/62)

Legislative and regulatory needs include:

1. State enabling legislation permitting the establishment of tax-supported vector control districts in any county of Georgia.

2. Regulations to require the control of wasteful flow from artesian wells.

Needs pertaining to surveillance and technical assistance include:

1. Extensive surveys of vector disease occurrence and vector problems.

2. Increased training of local health department personnel in vector control intelligence.

3. Expansion of entomologic and engineering consultative services to agencies, industries, and individuals concerned with water and related land resource development.

Some of the major research needs include:

1. Development of better permanent control techniques in salt marshes that will control mosquitoes, sand flies, and other vectors and at the same time be helpful to other interests, such as wildlife conservation.

2. Development of better equipment and methods for constructing and maintaining water management ditches.

3. Development of new agricultural and industrial uses for idle coastal land.

4. Improved methods for the sanitary handling of manure and other wastes on livestock and poultry farms including the possible use of stabilization ponds for disposal of wastes and for irrigation and fertilization.

5. Improved design for catch basins so that they do not hold water.

6. Development of new or modified chemical formulations which would overcome insecticide resistance problems and present less danger to water supplies.

7. Development of improved equipment and application techniques for chemical control of vectors in urban areas.

(6/1/62)

Vector control program needs in the Basin include:

1. The establishment of mosquito control districts in Dixie and Levy Counties, Florida. Each district would need about 3 draglines for permanent control work.
2. The development of countywide water management systems and programs.
3. Increased use of sanitary landfills both in towns and in counties. Many lowlands exist in the Basin that could be filled profitably using the sanitary landfill method.
4. Further development of countywide refuse collection and disposal systems.
5. Increased implementation of a program by Federal, State, and local interests to eradicate infestations of alligatorweed, water hyacinths, and other obnoxious weeds in the Basin.

State aid to organized mosquito control agencies in Florida has proven very successful. State aid in Florida includes funds, supplies, services, and equipment. A similar aid program is needed in Georgia.

In order that vector control programs will be compatible with multipurpose functions, it is essential that there be coordination between all interests concerned.

POTENTIAL PROBLEMS AND SOLUTIONS

Based on present knowledge, the one vector problem that appears to be on the rise and could be a significant one in the Suwannee Basin is mosquito-borne encephalitis--both the Eastern and St. Louis strains. Eastern encephalitis has caused serious losses among horses in the Basin. Sooner or later it could cause epidemics among man, as was true in New Jersey in 1959 (this constituted New Jersey's first confirmed human cases, even though it had killed horses there for at least 50 years). The Eastern disease occurs principally in areas with vast fresh-water swamps and salt marshes (Coastal Plain).

St. Louis encephalitis--a human disease--is not known to have occurred in the Basin, but it has recently been reported in Pinellas County, Florida. This disease presents a threat to communities that allow uncontrolled production of Culex mosquitoes.

On the basis of current knowledge concerning mosquito-borne encephalitis, the only feasible approach to control of the disease is a program of prevention--mosquito control for the community, or population groups, and protection against mosquito bites for the individual.

(6/1/62)

Increases in transmission of enteric infections by houseflys could increase due to changes in agricultural practices together with further "suburbia" developments.

COSTS AND BENEFITS

The principal benefit of any well-organized vector control programs is to provide adequate safeguards to public health. This includes freedom of disease and infirmity which is difficult to evaluate in dollars. Recent research studies have shown that permanent brain and motor damage, especially in small children, frequently results from cases of mosquito-borne encephalitis. The prevention of just one death or case of permanent damage would amply justify the amount of money proposed for vector control work in any one of the towns or counties in this Basin.

Another benefit of vector control programs would be acceleration of development and use of waterfront land. It is common knowledge that excessive numbers of salt-marsh mosquitoes and other vectors on such land are an impediment to industrial plants, subdivision developments, and recreational areas.

Another benefit would be to provide economic safeguards, particularly with reference to tourism or resort areas. This is exemplified by the 1959 outbreak of Eastern encephalitis in New Jersey. Although this outbreak involved only 33 human cases with 21 deaths during a 2-month period, it was estimated that the episode caused a loss to Atlantic City hotels of $2,000,000.

The estimated cost of needed vector control programs are included in Table PH-1. Present expenditures are approximately $100,000 per year and estimated needs for a minimum program are in excess of $250,000 per year. Studies in the Chatham County, Georgia area have shown that the total cost of the mosquito control program is being substantially balanced by reduced costs to families in the purchase of household sprays, aerosol bombs, and repellents.

The estimated cost of rural rat control programs will be balanced several times by savings from rat damage to stored farm products.

(6/1/62)

TABLE PH-1
VECTOR PROBLEMS AND PROGRAMS
SUWANNEE BASIN

Location	Vector Problem Degree			Annual Cost of Vector Control Program*		Refuse Disposal	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
FLORIDA									
Alachua County, Fla.				$31,000	$50,000				
Bradford County, Fla.				10,900	20,000				
Dixie County, Fla.				None	35,000				
Lake City, Fla. 9,465		F	M R T	5,000	15,000	Open dump	Light	Light	Sanitary landfill in plan stage
Levy County, Fla.				19,400	40,000				Includes county rat control prog.
Live Oak, Fla. 6,544		M F	R T	See Suwannee County		Sanitary landfill	Moderate	Light	
Madison County, Fla.				1,600	15,000				
Madison, Fla. 3,239	M	F	R T	See Madison County		Open dump	Moderate	Light	
Suwannee County, Fla.				12,500	25,000				
GEORGIA									
Adel, Ga. 4,321		M F R	T	None	8,000	Modified sanitary landfill	Light	Moderate	Sewage treatment plant needed
Colquitt County, Ga.				6,000 county rat control Program	6,000 continue pres. pro.	Modified sanitary landfill for city of Moultrie			

105<

TABLE PH-1 (CONT'D)

Location	Vector Problem Degree			Annual Cost of Vector Control Program*		Refuse Disposal	Storm Water Drainage Problems	Open Water with Sewage Problems	Comments
	1	2	3	Present	Needed				
GEORGIA (cont'd)									
Fitzgerald, Ga. 8,781	M	F	R T	None	$15,000	Open dump	Light	Light	Midge problem on stab. pond in summer
Hahira, Ga. 1,297		M F R		None	4,000	Open dump	Moderate	Moderate	Sewage stab. pond being planned
Homerville, Ga. 2,634	M	F	R T	None	4,000	Open dump	Moderate	Light	
Lakeland, Ga. 2,236	M	R F	T	None	5,000	Open dump	Light	Moderate	Sewage treatment plant needed
Lowndes County, Ga.				6,000 county rat control program	6,000 continue present program				
Nashville, Ga. 4,070	M F	R T		5,000	10,000	Modified sanitary landfill	Light	Moderate	Sewage treatment plant needed
Quitman, Ga. 5,071	M	F R	T	None	15,000	Open dump	Light	Light	Need for mosquito drainage work
Tifton, Ga. 9,903		M F	R T	None	12,000	Placed in trenches. Burned, but not covered	Light	Moderate	Small town rat control program
Valdosta, Ga. 30,652	M	F R T		4,000	20,000	Modified sanitary landfill	Moderate	Light	

*M - Mosquitoes
R - Rats
F - Flies
T - Ticks

1 - Severe
2 - Moderate
3 - Light

*Costs of refuse collection and disposal are not included in this table.

AIR POLLUTION

PROBLEMS

Eleven sources of industrial air pollution are known to exist in the Suwannee Basin. In most instances, these are local sources affecting small areas. The predominate problems are smoke, dusts, and odors. One large source, a pulp mill, is located in Lowndes County, Georgia.

Other smaller air pollution producing industries are scattered throughout the Basin, but no complaints have been received concerning these sources.

There has been no proof of health damage in the Basin due to sources of air pollution, but nusiances have occurred as the result of odors , dusts, and gases being released. General information from Florida indicates that municipal air pollution problems are associated with burning garbage and trash dumps. No inventories have been made of municipal or private sources of air pollution in the Basin. Air-borne pollen is a problem at certain times of the year.

STATUS OF EXISTING PROGRAMS

Public Law 159-84th Congress and its amendments provide for "Federal technical services and financial aid to State and local government air pollution control agencies and other public or private agencies and institutions in the formulation and execution of their air pollution abatement research programs". The Surgeon General of the Public Health Service may (1) encourage cooperative activities by State and local governments for the prevention and abatement of air pollution, (2) collect and disseminate information relating to air pollution and the prevention and abatement thereof, (3) conduct investigations and research and make surveys, and (4) prepare and publish reports and make appropriate recommendations with regard to the control of air pollution.

The Industrial Hygiene Service, Georgia Department of Public Health, has maintained records of complaints on industrial air pollution problems since 1945. Control measures used have consisted of investigation of these complaints and, where justified, discussion with the offending parties to work out a solution satisfactory to all persons concerned. During the period 1950-1959, five cases were brought to court; however, none of these were in the Suwannee Basin.

Work is underway by the Georgia Department of Public Health and the Public Health Service on a statewide survey to locate all sources of air pollution in Georgia. The survey began January 1, 1961, and as of April 1962 a preliminary draft report had been prepared.

(6/1/62)

The Florida State Board of Health has recently completed a survey of sources of air pollution and has published "A Report on Florida's Air Resources". The 1957 Florida Air Pollution Control Act established an Air Pollution Control Commission in the State Board of Health and provided for the administrative organization to enforce air pollution control rules and regulations. The Act provides for establishment of air pollution control districts, but none are operating in the SERB area at this time. The survey report together with the authority for control provides a sound basis for carrying out an active and effective program.

Both Georgia and Florida State Health Departments cooperate with the Public Health Service in the National Air Sampling Network Program. Urban sampling stations located in the SERB Area are Atlanta, Augusta, Savannah, Columbus, and Macon, Georgia. Others are operated just outside the SERB Area, but no sampling station is located within the Suwannee Basin.

EXISTING NEEDS

Available data indicates a need for control of sources of air pollution in the Basin. However, additional data on the specific pollutants and the extent of the problem are necessary before the problems and needs can be fully evaluated.

In the September 1959 report "Industrial Air Pollution Problems in Georgia", a need was expressed for a comprehensive study of air pollution problems in Georgia. The survey will recommend the type of legislation and programs needed and will suggest facilities required to implement a control program in Georgia.

The September 1959 Georgia report also indicated a need of some positive research for control of the industrial air pollution problems. The need for research of this type is in the following order of importance: pulp and paper industry, rendering plants, industries disseminating oxides of nitrogen and sulfur, and the kaolin, talc, slate, and fuller's earth industry.

It is noted that most of the available data on air pollution is for industrial sources. Sources of air pollution and corrective measures needed should also be determined for municipal and private air polluters.

POTENTIAL PROBLEMS AND SOLUTIONS

The chemical, pulp and paper, and meat packing industries are the major industries expected to expand production in the Suwannee Basin during the period 1960-2000. The types of air pollution expected from these industries would include fumes and gases, odors, particulate matter, and smoke. Only the chemical and pulp and paper industries are expected to produce problems affecting fairly large areas.

(6/1/62)

Measures should be considered for correcting air pollution from municipal, commercial and private sources. This would call for meteorological studies as an aid to zoning and planning functions, the preparation of air quality guides and eventually the establishment of air pollution emission criteria for logical air basins.

Research has produced methods and devices that will eliminate gases, smoke, and particulate matter from the atmosphere. New industry should be required to install air pollution abatement devices and measures should be adopted now to control present polluters of the atmosphere.

Recommendations in "Florida's Air Resources" point out the solution to their State's air pollution problems as:

1. Adoption of legislation to permit and foster establishment and operation of county and multi-county air pollution control programs throughout the State.

2. Review and approval of plans for construction and alteration of establishments which may cause air pollution.

3. Enabling legislation to permit county-wide zoning.

4. Adequate staffing and financing to carry out a program of surveillance, control, assistance, and research in air pollution.

COSTS AND BENEFITS

The cost of control of air pollution cannot be evaluated since specific quantity and quality information is not available for the sources.

Benefits to be derived from air pollution abatement result from reduction in nuisances, effects on public health, and decrease in maintenance costs of buildings and of personal property. Benefits are considered to be equal to costs of air pollution control.

RADIOLOGICAL HEALTH

PROBLEMS

The radiological health problem is best determined by considering all of the following sources of radiation: air, water, milk and food, and local sources such as medical and environment. The total effect of these sources is not known for the Suwannee Basin.

There are no nuclear reactors and no licensed radioactive isotope users in this Basin.

Data collected by State and Federal agencies on the radiological quality of the Basin's waters are shown in Table PH-2. The results of weekly composite samples of surface water collected by the Public Health Service for the U.S. Study Commission, SERB is included.

STATUS OF EXISTING PROGRAMS

The Florida State Board of Health collected 3,500 statewide water samples for radiological analysis during the period March 1958 to October 1960. The sampling program includes surface and ground water sources with permanent sampling stations on each watershed in the State. Progress Report No. 4-"Radiological Surveillance Program, March 1958 through October 1960" summarizes radioactivity in water as follows:

"1. A marked decrease in the radioactivity of surface waters and rainfall became apparent in the late spring of 1958 and continued until the French weapons testing the latter part of February 1960. The activity from this testing dropped off by May 1960 and continues to be undetectable.

2. An increase in the activity of underground water has not been found.

3. A few areas in the State, principally the phosphate ore bearing regions, have shown a little more alpha activity in both surface and underground waters than other portions of the State. This activity is negligible and much below maximum permissible levels."

There are no Federal, State, or local radiological health program activities operating in the Georgia portion of the Basin. The Gerogia Department of Public Health plans a surface water monitoring program to gather data on background counts in their streams. Georgia and Florida both wish to assume the job now being done by the Atomic Energy Commission of inspecting the facilities and operations of licensed users of radioisotopes.

Other activities of the States include maintaining a list of Atomic Energy Commission licensed isotope users. Florida also surveys sites for industrial radioisotope users.

EXISTING NEEDS

The air phase of surveillance has never been undertaken by the States due to lack of funds, personnel, and equipment. Development of this phase of the program is increasingly important.

There is a need for control of radiological health hazards associated with the use and disposal of radioisotopes in the Basin.

(6/1/62)

TABLE PH-2
RADIOACTIVITY IN WATER
SUWANNEE BASIN

Sampling Station	Period of Analysis	No. of Analyses	Gross Alpha (uuc/1) Avg.	Gross Alpha (uuc/1) Max.	Gross Alpha (uuc/1) Min.	Gross Beta (uuc/1) Avg.	Gross Beta (uuc/1) Max.	Gross Beta (uuc/1) Min.	Remarks
Florida Surface Waters									
Suwannee River, Vista	1960	1	0.8			6.6			Taken at mid-channel
Suwannee River, Fowler's Bluff	1960	1	0.2			12.3			Levy Co.
Alligator Lake, Hwy 100	1958	3	0.5(2)	0.8	0.3	44.3	77.0	9.9	
Cherry Lake	1958	1	0.1			14.9			
Corbetts Lake, Hwy 141	1958	1	0.1			28			
Itchtucknee River, U.S. Hwy 27	1958	2	0.4(1)			1.2	1.4	1.0	
Lake Jeffrey	1958	1	0.3			44			
Lake Lona	1958	1	0.5			82			
Lake Francis, Madison	1958	1				17			
Octahatchee Lake	1958	1	0.2			30			S.W. corner
Rose Creek, Hwy 441	1958	1	0.1			32			Drains into sink hole
Spring-7th Day Advent. Camp, Hwy 441, Olena Park	1958-59	2	0.8(1)			31.8	63	0.7	
Spring-Hwy 136, road to Hamilton	1958	1	0.4			50			

TABLE PH-2 (CONT'D)
RADIOACTIVITY IN WATER
SUWANNEE BASIN

Sampling Station	Period of Analysis	No. of Analyses	Gross Alpha (uuc/l)			Gross Beta (uuc/l)			Remarks
			Avg.	Max.	Min.	Avg.	Max.	Min.	
Florida Surface Waters (cont'd)									
Spring-Adams Bridge on Hwy 51, Luraville	1958	1				33			
Suwannee River, Hwy 90, Ellaville	1959	1	0.8			63			
Suwannee River at Dixie-Levy Line, Hwy 98, Old Town	1958	1	0.4			5.3			
Withlacoochee River near Pinetta, Fla.	1960-61	3	7.0	18.9	0.0	3.9	5.6	2.9	Weekly composites collected by Public Health Service for U.S. Study Commission
Florida Ground Water									
Levy County, off State Hwy 347, Hudson well	1960	1	1.2			4.9			Shallow well, 35 feet
Levy County, off Hwy 345 Darby well	1960	2	3.7	3.7	3.7	14.5	19.3	9.7	Shallow well
Levy County, Hwy 19 and 98 between Fannin Springs and Chiefland-J.D. Matthews well	1960	1	1.4			2.6			Shallow well, 40 feet
Vista Fish Camp, Suwannee R.	1960	1	5.5			13.2			Shallow well, 40 feet
Lake Butler, well No. 1	1959	1				5.2			
Cherry Lake, Utilities Well	1958	1				0.7			

TABLE PH-2 (CONT'D)
RADIOACTIVITY IN WATER
SUWANNEE BASIN

Sampling Station	Period of Analysis	No. of Analyses	Gross Alpha (uuc/l) Avg.	Gross Alpha (uuc/l) Max.	Gross Alpha (uuc/l) Min.	Gross Beta (uuc/l) Avg.	Gross Beta (uuc/l) Max.	Gross Beta (uuc/l) Min.	Remarks
Florida Ground Water (cont'd)									
Greenville Municipal Well	1958	1	0.2			2.6			
Jasper Municipal Well	1958	1				0.7			
Madison, Conway Quarters Well	1958	1				2.9			Deep well
Mayo Municipal Well	1958	1				2.1			Finished water
Old Town, Std. Ser. Sta. well	1958	1	0.4			1.0			
Raiford Prison well, at powerhouse	1959	1				4.7			
Raiford Prison well, Irrigation Plant	1959	1				3.7			
White Springs Municipal well	1958	1	0.1			5.6			
Wilcox private well	1958	1	0.2			1.2			
Florida-Miscellaneous Sources									
Hyacinths, Suwannee River at Vista	1960	1	4.2/g			107/g			
Bottom Muck, Suwannee River at Vista	1960	1	133.2/g						
Hyacinths, Suwannee River at Landing, Camp Azalea Fish Camp	1960	1	24.8/g			26.4/g			
Muck, Suwannee River at Landing Camp Azalea Fish Camp	1960	1	51.2/g			25.5/g			

TABLE PH-2 (CONT'D)
RADIOACTIVITY IN WATER
SUWANNEE BASIN

Sampling Station	Period of Analysis	No. of Analyses	Gross Alpha (uuc/l) Avg.	Gross Alpha (uuc/l) Max.	Gross Alpha (uuc/l) Min.	Gross Beta (uuc/l) Avg.	Gross Beta (uuc/l) Max.	Gross Beta (uuc/l) Min.	Remarks
Florida-Miscellaneous Sources (cont'd)									
Lake City, final sewage effluent	1958	1	2.2			12			
Georgia Surface Waters									
Alapaha River near Willacoochee, Ga.	1960-61	3	2.3	5.3	0.0	3.4	5.7	0.5	Weekly composites collected by Public Health Service for U.S. Study Commission
Alapaha River at Statenville, Ga.	1960-61	3	8.5	14.0	0.0	5.1	9.5	2.1	Weekly composites collected by Public Health Service for U.S. Study Commission
Little River near Adel, Ga.	1960-61	3	9.8	13.0	0.0	4.4	6.7	2.5	Weekly composites collected by Public Health Service for U.S. Study Commission

NOTE: Number in parentheses shows number of analyses upon which the average was computed if different than the total number shown.

114<

Georgia needs additional funds and personnel to enable it to expand the water and air monitoring programs so as to establish a statewide radiation background picture for future use. Assistance is also needed in a surveillance program for radioactive contamination of milk and food supplies.

POTENTIAL PROBLEMS AND SOLUTIONS

It is expected that the use of radioisotopes will increase in the future. Control of their use is a State responsibility. Funds and personnel should be made available to permit the states to have a balanced and effective program.

Solutions to future problems include the following:

1. Enactment of specific State legislation to control radioactive pollutants and license radioisotope users.
2. Provision of additional funds and personnel for the present Statewide programs of control, licensing and monitoring of air, water, milk, and food.

SOLID WASTES

INTRODUCTION

Most communities collect and dispose of solid wastes as a governmental service, financing the operation by general taxation or by a special service charge. In a few instances, the collection and disposal is left to the individuals producing the waste or to private collectors who charge a fee for the service.

Methods of disposal vary, including dumping (and burning) on the surface, placing in sanitary landfills, and incineration. The amount of waste produced on a national average is 0.8 to 1.0 cubic yard or about 650 pounds per person per year (approximately 2 pounds per person per day).

Incineration is considered as one of the best methods of disposal. However, incineration of waste is not economical for small communities since it usually requires a population of 50,000 or more to support an efficient operation.

Sanitary landfills are the best method of waste disposal for any small community having suitable land available within reasonable hauling distance, and they can be used at a cost which is not prohibitive. They are an effective and proven method, accepted by the State departments of health.

PROBLEMS

Open dumps with burning of some garbage and combustible material are the most common method of solid waste handling in the small communities of the Basin. This is not an acceptable method because unburned garbage and uncovered refuse become a major breeding place for insects and rodents, and burning dumps create an extensive smoke and odor problem. Costs, ignoring benefits, for dump operations are approximately 50 percent of that for sanitary landfills.

STATUS OF EXISTING PROGRAMS

State and local health departments have adequate authority to control the storage, collection, and disposal of solid wastes. Only one community in the Basin operates an acceptable type of solid wastes desposal program. Eight others operate programs where certain types of wastes are burned at dumps, or the fill is covered at other than daily intervals. The 25 other reporting cities operate open dumps. Undoubtedly other cities in Georgia operate open dumps, or as is the case of many small cities under 500 population in Florida, leave the disposal problem to be handled on an individual basis.

The City of Valdosta is pioneering a new system of business district refuse storage and collection which will improve environmental sanitation and reduce operational costs for refuse handling. The city initially purchased 131 large "containerized" refuse storage boxes for the downtown business area. Later 132 additional large boxes were purchased for schools, apartment areas, and out-lying business areas. Two compactor trucks are used to empty the boxes at the storage site.

Crisp County has a unique countywide refuse system. A concrete refuse storage station was built in each community club district. Residents haul their refuse to the central storage point. County trucks are used to collect the refuse at regular intervals.

EXISTING NEEDS

There is a need in the Basin to provide approved waste disposal practices in an additional 49 communities which have a population sufficient to support a refuse collection and disposal program. In communities of under 500 population, good housekeeping practices can be practiced by the individual. Most communities will need to adopt regulations to enable them to cope with the problem.

POTENTIAL PROBLEMS AND SOLUTIONS

By 1975, it is estimated that 65 sanitary landfills serving 209,400 persons will be needed in the Basin. By 2000, it is estimated that 70 sanitary landfills serving a population of 310,400 will be required.

Land requirements for the communities operating landfills are based on a need of one acre per 10,000 population served per year. These requirements for the period 1960-2000 are shown in Table PH-3.

TABLE PH-3
REQUIREMENTS FOR SANITARY LANDFILLS
SUWANNEE BASIN

Period of Time	Number of Communities	Avg. Population to be Served	Acres Required
1960-1964	50	122,200	45*
1965-1974	65	181,800	180
1975-2000	70	259,900	650
		Total	875

* Does not include land requirements for modified landfills.

COSTS AND BENEFITS

Present costs for construction of incinerators ranges from $2000 to $4000 per ton daily capacity. Operational costs vary considerably with the City of Atlanta reporting $1.48 per ton for the year 1959, and $1.27 per ton for 1960. Other cities report costs two to three times this amount.

Costs of operation of sanitary landfills average $0.50 to $1.00 per ton of refuse handled. Cities as large as Los Angeles, California and New York City use this method of disposal. New York City's experience has shown that disposal by sanitary landfills cost approximately half that of incinerators.

Cost of operation of a solid refuse program including collection and disposal will vary with each community but will, depending on the size of the community, range from $1.00 to $4.50 per person per year. Based on a scaled cost, annual cost for a solid refuse program in the Suwannee Basin are shown on Table PH-4.

TABLE PH-4
SOLID WASTES PROGRAM ANNUAL COSTS
SUWANNEE BASIN

Type of Operation	1960	1965	1975	2000
Sanitary Landfills				
Collection and Disposal	$185,000	$438,000	$545,000	$764,000*
Totals	$185,000	$438,000	$545,000	$764,000

* Includes system for one city over 50,000.

The total cost for the sanitary landfill program is considered to be all operation and maintenance. All operation and maintenance costs include collection as well as disposal of the solid refuse.

SUMMARY AND CONCLUSIONS

SUMMARY

Insect-borne diseases do not now constitute a major health problem in the Basin. The following diseases, however, do present a continuous threat: encephalitis, malaria, typhus fever, Rocky Mountain spotted fever, and conjunctivitis. The most serious insect problems in the Basin are the salt-marsh mosquitoes in the seashore counties. A portion of enteric disease transmission in the Basin is by houseflies.

Important vector problems due to man's activities include those associated with the disposal of sewage, the storage, collection and disposal of refuse, water-holding catch basins, uncontrolled flow from artesian wells, and the accumulation and disposal of feed wastes and manure on farms.

There is no statewide enabling legislation for vector control districts in Georgia, but adequate legislation of this nature does exist in Florida.

Most towns in the Basin have programs primarily for the control of mosquitoes and secondarily to control flies, rats, and other vectors. Present vector control programs consist of four countywide mosquito control programs, two countywide rodent control programs, and several municipal mosquito control programs.

Only one large industrial source of air pollution is present in the Basin, but there are a number of small local sources. There has been no proof of health damage from these sources. Studies have been completed on all sources of air pollution in the State of Georgia and Florida.

The overall extent of the radiological health problem has not been determined. Air, water, and other monitoring programs are underway in Florida and to a lesser degree in Georgia. No problem areas have been found as a result of these limited monitoring activities.

Only one city, serving less than 5 percent of the total population of cities over 500 population, has a satisfactory method of solid wastes disposal. Fifty-five percent of the total population in towns over 500 persons is served by solid waste disposal facilities which with little effort and expense could be operated satisfactorily. The remaining 40 percent of this population have inadequate methods of solid wastes disposal.

CONCLUSIONS

Control measures and supportive services needed to reduce public health problems associated with insect and rodent vectors are:

1. State enabling legislation permitting the establishment of tax-supported vector control districts in any county in Georgia.
2. Regulations requiring the control of wasteful flow from abandoned artesian wells.
3. More extensive surveys of vector disease occurrence and vector problems.
4. Increased training of local health department personnel in vector control intelligence.
5. Expansion of entomologic and engineering consultative services to agencies, industries, and individuals concerned with water and land resource developments.
6. Development of better permanent control techniques in salt marshes to serve multi-interests.
7. Development of better equipment and methods for constructing and maintaining water management ditches.
8. Establishment of mosquito control districts in Levy and Dixie Counties, Florida.
9. Development of countywide water management systems and programs.

10. Improved design for catch basins so that they do not hold water.

11. Increased use of sanitary landfills in towns and in counties, and use of countywide refuse collection systems.

12. Increased use of sewers and central treatment plants in new subdivisions in lieu of septic tanks.

13. Development of improved methods for the sanitary handling of manure and other wastes on livestock and poultry farms.

14. Implementation of an increased program for the control and progressive eradication of alligatorweed, water hyacinths, and other obnoxious weeds in the Basin.

15. Better coordination between agencies so that vector control programs are compatible with multipurpose functions.

16. Establishment of countywide rodent control programs where none exist.

17. Development of effective techniques for the control of eye gnats and improved methods of control of dog flies.

18. Initiation of a state-aid financial program in Georgia.

Based on present knowledge, a vector problem that appears to be on the rise and could be a significant one in the Basin by 1975 or 2000 is mosquito-borne encephalitis. At present the only feasible approach to control of encephalitis is a program of prevention--mosquito control for the community or population groups and protection against mosquito bites for the individual.

The air pollution surveys already completed in Florida and Georgia should be utilized as a basis for planning future control programs. Study and research should be undertaken immediately to determine the feasibility and desirability of controlling air pollution from the processing of pulp and the manufacturing of wood product materials. Since the economy of controlling this particular source of air pollution is closely related with the control of water pollution from this industry, the two programs should be coordinated.

Funds are needed for the expansion of the radiological monitoring program in Georgia and to a lesser degree in Florida. This surveillance program on water, air, milk and food, and related items is essential in this nuclear age.

Satisfactory solid wastes programs should be developed in forty-nine Georgia and Florida communities in the Basin. Funds for such a program could be obtained through local taxation. Estimated annual

Only one large industrial source of air pollution is present in the Basin, but there are a number of small local sources. There has been no proof of health damage from these sources. Studies have been completed on all sources of air pollution in the State of Georgia and Florida.

The overall extent of the radiological health problem has not been determined. Air, water, and other monitoring programs are underway in Florida and to a lesser degree in Georgia. No problem areas have been found as a result of these limited monitoring activities.

Only one city, serving less than 5 percent of the total population of cities over 500 population, has a satisfactory method of solid wastes disposal. Fifty-five percent of the total population in towns over 500 persons is served by solid waste disposal facilities which with little effort and expense could be operated satisfactorily. The remaining 40 percent of this population have inadequate methods of solid wastes disposal.

CONCLUSIONS

Control measures and supportive services needed to reduce public health problems associated with insect and rodent vectors are:

1. State enabling legislation permitting the establishment of tax-supported vector control districts in any county in Georgia.
2. Regulations requiring the control of wasteful flow from abandoned artesian wells.
3. More extensive surveys of vector disease occurrence and vector problems.
4. Increased training of local health department personnel in vector control intelligence.
5. Expansion of entomologic and engineering consultative services to agencies, industries, and individuals concerned with water and land resource developments.
6. Development of better permanent control techniques in salt marshes to serve multi-interests.
7. Development of better equipment and methods for constructing and maintaining water management ditches.
8. Establishment of mosquito control districts in Levy and Dixie Counties, Florida.
9. Development of countywide water management systems and programs.

10. Improved design for catch basins so that they do not hold water.

11. Increased use of sanitary landfills in towns and in counties, and use of countywide refuse collection systems.

12. Increased use of sewers and central treatment plants in new subdivisions in lieu of septic tanks.

13. Development of improved methods for the sanitary handling of manure and other wastes on livestock and poultry farms.

14. Implementation of an increased program for the control and progressive eradication of alligatorweed, water hyacinths, and other obnoxious weeds in the Basin.

15. Better coordination between agencies so that vector control programs are compatible with multipurpose functions.

16. Establishment of countywide rodent control programs where none exist.

17. Development of effective techniques for the control of eye gnats and improved methods of control of dog flies.

18. Initiation of a state-aid financial program in Georgia.

Based on present knowledge, a vector problem that appears to be on the rise and could be a significant one in the Basin by 1975 or 2000 is mosquito-borne encephalitis. At present the only feasible approach to control of encephalitis is a program of prevention--mosquito control for the community or population groups and protection against mosquito bites for the individual.

The air pollution surveys already completed in Florida and Georgia should be utilized as a basis for planning future control programs. Study and research should be undertaken immediately to determine the feasibility and desirability of controlling air pollution from the processing of pulp and the manufacturing of wood product materials. Since the economy of controlling this particular source of air pollution is closely related with the control of water pollution from this industry, the two programs should be coordinated.

Funds are needed for the expansion of the radiological monitoring program in Georgia and to a lesser degree in Florida. This surveillance program on water, air, milk and food, and related items is essential in this nuclear age.

Satisfactory solid wastes programs should be developed in forty-nine Georgia and Florida communities in the Basin. Funds for such a program could be obtained through local taxation. Estimated annual costs for providing adequate refuse collection and disposal programs for 1965, 1975, and 2000 are $438,000, $545,000, and $764,000 respectively.

(6/1/62)

APPENDICES AND BIBLIOGRAPHY

APPENDIX
DEFINITIONS AND ABBREVIATIONS

1. cfs - cubic feet per second.
2. Garbage - putrescible animal and vegetable wastes resulting from the handling, preparation and consumption of foods.
3. gpcd - gallons per capita per day.
4. gpd - gallons per day.
5. mg - million gallons.
6. mgd - million gallons per day.
7. PE - population equivalent.
8. ppm - parts per million by weight.
9. Pollution, water - the addition of sewage, industrial wastes, or other harmful or objectionable material to water.
10. Quality, water - is defined as the expression of water characteristics in terms of its physical, chemical, bacteriological, biological, and radioactive content.
11. Resources, water - is defined as the water available to serve mankind and his civilization for the varied, complex, and often conflicting beneficial uses. These uses include sources for municipal and domestic supplies, agriculture, industrial development, and for recreation, propagation of aquatic life and other forms of wildlife, navigation and ultimate waste disposal.
12. Supplies, domestic water - are those supplies used for individual families, including those also serving tenant families living on the property. Domestic supplies do not include commercial establishments, schools, churches, or camps.
13. Supplies, industrial water - are considered as industrially owned supplies, primarily developed for process or cooling purposes but which might be incidentally used for sanitary purposes.
14. Supplies, municipal water - are public supplies serving a municipality or communities of 50 or more people.
15. Supplies, semi-public water - are supplies for schools, motels, camps, and other supplies serving water to the public; or commercial establishments not classed as municipal or industrial.
16. Wastes, municipal - include all liquid wastes received by community sewers.
17. Wastes, industrial - the liquid wastes from industrial processes as distinct from domestic or sanitary sewage.
18. Wastes, solid (or Refuse) - includes all wastes of a solid nature not otherwise disposed of to the sewers or to the atmosphere. This includes all putrescible and nonputrescible solid wastes such as garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and solid market and industrial wastes.
19. Wastes stabilization ponds - a properly engineered and operated pond for the biological reduction of organic wastes.

(6/1/62)

20. Water supply systems - includes the works and auxiliaries for collection, treatment and distribution of the water from the source of supply to the free-flowing outlet of the ultimate consumer.

Note: For the definition of any other terms which are used in this memoranda, refer to Glossary of Water and Sewage Control Engineering, 1949, American Society of Civil Engineers.

(6/1/62)

BIBLIOGRAPHY

1. American Society for Testing Materials. Manual on Industrial Water and Industrial Waste Water. Philadelphia, Pennsylvania, ASTM Special Technical Publication No. 148-D; 2nd Edition, 1959.

2. American Water Works Association. Water Quality and Treatment. New York, 2nd Edition, 1951.

3. California State Water Pollution Control Board. Water Quality Criteria. Sacramento, California, Publication No. 3; 2nd Printing, 1957.

4. Council of State Governments. Agencies Administering Water Resources in the Southern States. Chicago, 1960.

5. Council of State Governments. Statement of Basic Water Resource Policies in the Laws of the Southern States. Chicago, December 1960.

6. Drott Manufacturing Company. What Does Your City Pay for Refuse Disposal? Milwaukee, Wisconsin, May 1949.

7. Fair, G. M., and Geyer, J. C. Water Supply and Waste Water Disposal. New York: John Wiley & Sons, 1954.

8. Federal Inter-Agency Committee on Recreation. The Role of the Federal Government in the Field of Public Recreation. Government Printing Office, Washington, D. C., June 1949.

9. Federal Radiation Council. Background Material for the Development of Radiation Protection Standards. May 13, 1960.

10. Florida State Chamber of Commerce. Directory of Florida Industries, 1961.

11. Florida Development Commission, Arthur D. Little, Inc. Review of Major Segments of the Florida Economy and A Report on the Public Aspects of Land Development Practices. April 1960.

12. Florida State Board of Conservation. Chemical Character of Florida's Waters 1951 with supplements through 1959. Water Survey and Research Paper No. 6, November 30, 1951. Tallahassee, Florida.

13. Florida State Board of Conservation. Salt Water Intrusion in Florida - 1953. Water Survey and Research Paper No. 9, May 15, 1953. Tallahassee, Florida.

14. Florida State Board of Health. Florida's Air Resources. February 1961.

15. Florida State Board of Health, Bureau of Sanitary Engineering. *Progress Report No. 4, Radiological Surveillance Program*. March 1958 through October 1960.

16. Florida State Board of Health. *Sanitary Code of the State of Florida*. Revised 1951.

17. Florida State Board of Health. *Some Arthropods of Public Health Importance in Florida*. Florida Health Notes, January 1961.

18. Georgia Agricultural Experiment Station, University of Georgia, College of Agriculture. *Agricultural Resources in the Southeast River Basins of Georgia*. Athens, Georgia.

19. Georgia Department of Commerce. *Georgia Manufacturers - 1958* plus 1960 supplement. Atlanta, Georgia.

20. Georgia Department of Public Health. Unpublished Report, *Industrial Air Pollution Problems in Georgia*. September 1959.

21. Georgia State Division of Conservation. *The Availability and Use of Water in Georgia*. Bulletin No. 65; December 1956, Atlanta, Georgia.

22. Greene, Henry, and McCroan, J. E. Jr. "Residual Typhus Fever in Georgia," *The Journal of the Medical Association of Georgia*, April 1953.

23. Interstate Commission on the Potomac River Basin. Waste Treatment Guide. Washington, D. C., 1947.

24. Karstand, L. H. and others. "Eastern Equine Encephalomyelitis Virus Isolated from Three Species of Diptera from Georgia." *Science Magazine*, Vol. 125, No. 3244, (March 1, 1957), 395-396.

25. Mathis, Willis, Kilpatrick, John W., and Johnson, Harry F. DDT Resistance in *A. quadrimaculatus*. *Public Health Reports*, 75 (5): May 1960, 387-390.

26. McCroan, John E., Jr., Georgia Department of Public Health. "Eastern Equine Encephalomyelitis." *The Journal of the Medical Association of Georgia*. (December 1949).

27. McCroan, John E., Jr., and others. "The Status of Rocky Mountain Spotted Fever in the Southeastern United States." Presented at the 23rd Annual Meeting of the Southern Branch of the American Public Health Association, St. Petersburg, Florida, April 21-23, 1954.

(6/1/62)

28. National Association of Manufacturers and the Conservation Foundation. Water in Industry - A Survey of Water Use in Industry. December 1950.

29. Nordell, E. Water Treatment for Industrial and Other Uses. New York: Reinhold Book Division, 1951.

30. Pratt, Harry D. "The Changing Picture of Murine Typhus in the United States." Annuals of the New York Academy of Sciences, Vol. 70, Art. 3, (June 3, 1958), 516-527.

31. Rowan, Peter P., Jenkins, Kenneth H., and Butler, D. W. "Sewage Treatment Construction Costs." Journal of Water Pollution Control Federation, June 1960, Vol. 32, No. 6, 594-604.

32. Seelye, Elwyn E. Data Book for Civil Engineers, Volume II Specifications and Costs. New York: John Wiley & Sons, Inc., 1957.

33. Select Committee on National Water Resources, United States Senate. Water Resources Activities in the United States, Water Quality Management. Reprint No. 24 of 32, U. S. Government Printing Office, Washington, D. C., 1960.

34. Smallwood, Charles. A Special Report to the Public Health Service, Region IV, on Costs of Treating Textile Waste Waters, December 27, 1960.

35. Smith, D. B., Wakefield, J. W., Bevis, H. A., and Phelps, E. B. Stream Sanitation in Florida, Florida Engineering Series No. 1, University of Florida, 1954.

36. Stern, Arthur C. "Results of Three Years of Operation of the National Air Sampling Network." Presented at the 50th Annual Meeting of the Air Pollution Control Association held at St. Louis, June 2-6, 1957.

37. Thoman, John R., and Jenkins, Kenneth H. "Per Capita Construction Costs." Engineering-News Record, Vol. 161, 64, December 25, 1958.

38. Trackson Company. Sanitary Landfills. Milwaukee, Wisconsin.

39. U. S. Department of Agriculture Administrative Report to the United States Study Commission, Southeast River Basins concerning agriculture use of land and water resources in the Georgia segment of the Southeast River Basins.

40. U. S. Department of Commerce, National Bureau of Standards. Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure. Handbook 69. U. S. Government Printing Office, Washington, D. C., June 5, 1959.

41. U. S. Department of Commerce, Bureau of the Census. *1954 Census of Manufacturers plus other related supplements*.

42. U. S. Department of Health, Education and Welfare, Public Health Service. *A Digest of State Air Pollution Laws*. 1960.

43. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center, Brody, J. A., and Dunn, Frederick L. *CDC Malaria Surveillance Report--1958*. March 9, 1959.

44. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center, Pratt, Harry D. *Current Status of Some Important Arthropod-Borne Diseases in the United States*. Atlanta, Georgia, November 1959.

45. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. *Insect Control Training Manual*. Atlanta, Georgia, 1960.

46. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. *Insect Control Training Manual*. Atlanta, Georgia, 1960.

47. U. S. Department of Health, Education, and Welfare, Public Health Service. *1957 Inventory of Municipal and Industrial Waste Facilities*. Public Health Service Publication No. 622, Volume 4, U. S. Government Printing Office, Washington, D. C., 1958.

48. U. S. Department of Health, Education, and Welfare, Public Health Service, *Municipal Water Facilities, Inventory as of January 1, 1958*, Public Health Service Publication No. 775, Volume 4, U. S. Government Printing Office, Washington, D. C., 1960.

49. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. "The Law in Relation to Public Health (Lecture Notes of Ragner T. Westman)." Atlanta, Georgia, 1947.

50. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center, Barnes, Ralph C. *Mosquitoes and their Control*. May 16, 1955.

51. U. S. Department of Health, Education and Welfare, Public Health Service. *A report of the Advisory Committee on Revision of the Public Health Service 1946 Drinking Water Standards*. May 3, 1961.

(6/1/62)

52. U. S. Department of Health, Education and Welfare, Public Health Service. *Public Law 159 - 84th Congress, As Amended*. Washington, D. C. September 22, 1959.

53. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. *Rat-Borne Diseases Prevention and Control*. Atlanta, Georgia, 1959.

54. U. S. Department of Health, Education and Welfare, Public Health Service. *Register of Air Pollution Analysis*, Volume II, January 1, 1956 - June 30, 1959, U. S. Government Printing Office, Washington, D. C.

55. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. *The Sanitary Landfill*. Atlanta, Georgia, January 5, 1958.

56. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center, Beadle, Leslie D., and Rowe, John A. "Sewage Lagoons and Mosquito Problems." Presented at Symposium on Waste Stabilization Lagoons, Kansas City, Missouri, August 3, 1960.

57. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. (Federal Security Agency). *Source Data on Endemic Typhus Fever Morbidity*. Atlanta, Georgia. October 1947.

58. U. S. Department of Health, Education and Welfare, Public Health Service. Manual of Laws and Regulations, *Federal Water Pollution Control Act, Public Law 660 as amended by Public Law 87-88 approved July 20, 1961*, U. S. Government Printing Office, Washington, D. C., 1961.

59. U. S. Department of Health, Education and Welfare, Public Health Service, Communicable Disease Center. *Surveillance of Arthropod-Borne Encephalitis in the United States--1958*, December 18, 1959.

60. U. S. Department of Health, Education, and Welfare, Public Health Service, (Federal Security Agency). *Southeast Drainage Basins, A Cooperative State-Federal Report on Water Pollution.* Water Pollution Series, No. 13, Atlanta, Georgia, 1951.

61. U. S. Department of Interior, Geological Survey. *Hydrologic Characteristics of the Southeast River Basins*. Prepared for the U. S. Study Commission, Southeast River Basins, Atlanta, Georgia, 1960.

62. U. S. Department of Interior, Geological Survey. *The Industrial Utility of Public Water Supplies in the United States, 1952*. Water Supply Paper 1299, U. S. Government Printing Office, Washington, D. C., 1954.

63. U. S. Department of the Interior, Geological Survey, Surface Water Supply of the United States--1959, Part 2B, South Atlantic Slope Basins, Ogeechee River to Pearl River, Water Supply Paper No. 1624, U. S. Government Printing Office, Washington, D. C., 1960.

64. U. S. Study Commission - Southeast River Basins. Public Law 85-850. U. S. Government Printing Office, Washington, D. C., 1958.

65. U. S. Study Commission - Southeast River Basins. Water Quality Basic Data - Southeast River Basins, prepared by the Public Health Service, Atlanta, Georgia, 1961.

66. Water Resources Committee of the National Resources Committee. Drainage Basin Committee Report for the Southeastern Basins. U. S. Government Printing Office, Washington, D. C., December 1937.

(6/1/62)